

# Railway Mechanical Engineer

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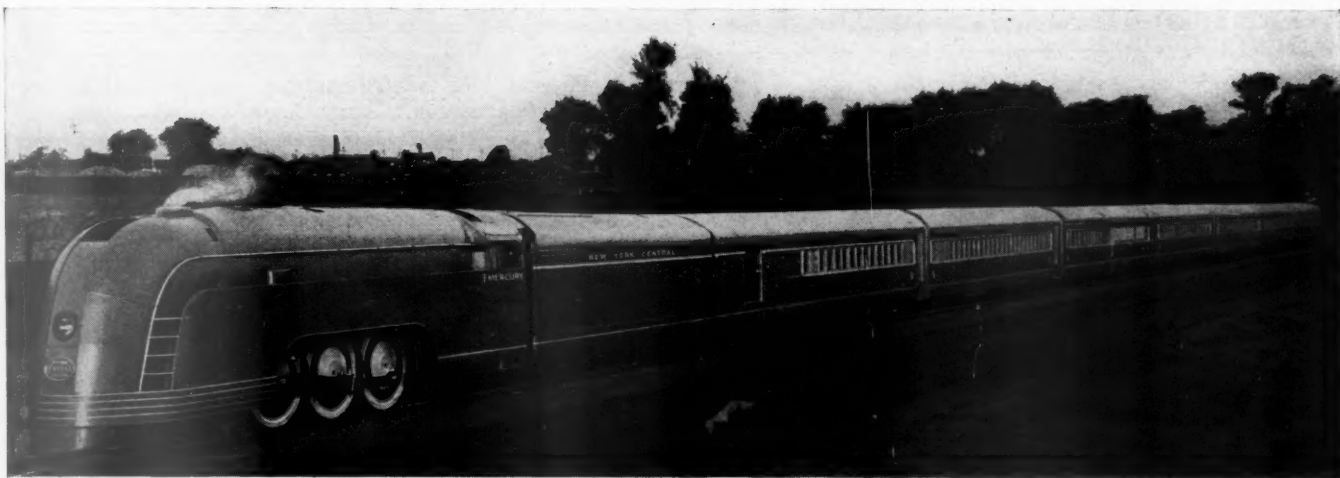


# Republic Steel

## C O R P O R A T I O N

GENERAL OFFICES: CLEVELAND, OHIO





### **Distinctive Design Features**

## N. Y. C. Train "The Mercury"

ON JUNE 25 the New York Central christened its new Cleveland-Detroit high-speed, streamline, steam train "The Mercury" at its Beech Grove, Indiana shops, where the train was built. The Mercury, which consists of seven coaches, two of which are fitted for Pullman parlor-car service, represents a complete departure from conventional design and embodies changes which combine to produce a train free from the corridor-like appearance characteristic of the interiors of long passenger cars; as well as one which starts and stops with an absence of shocks and in which the riding is smooth and free from vibrations.

The complete interior and exterior of the train, including the exterior of the locomotive, was designed by Henry Dreyfuss, industrial designer, working in close co-operation with the New York Central's equipment engineering department which was responsible for the execution of the designs and for working out all of the mechanical features of the train.

The train is intended for daily round-trip service between Cleveland and Detroit, on which it was inaugurated on July 15. The distance between terminals is 164 miles and the run each way will require 2 hrs. 50 min., a schedule speed of 57.9 m.p.h.

### **Structural Features**

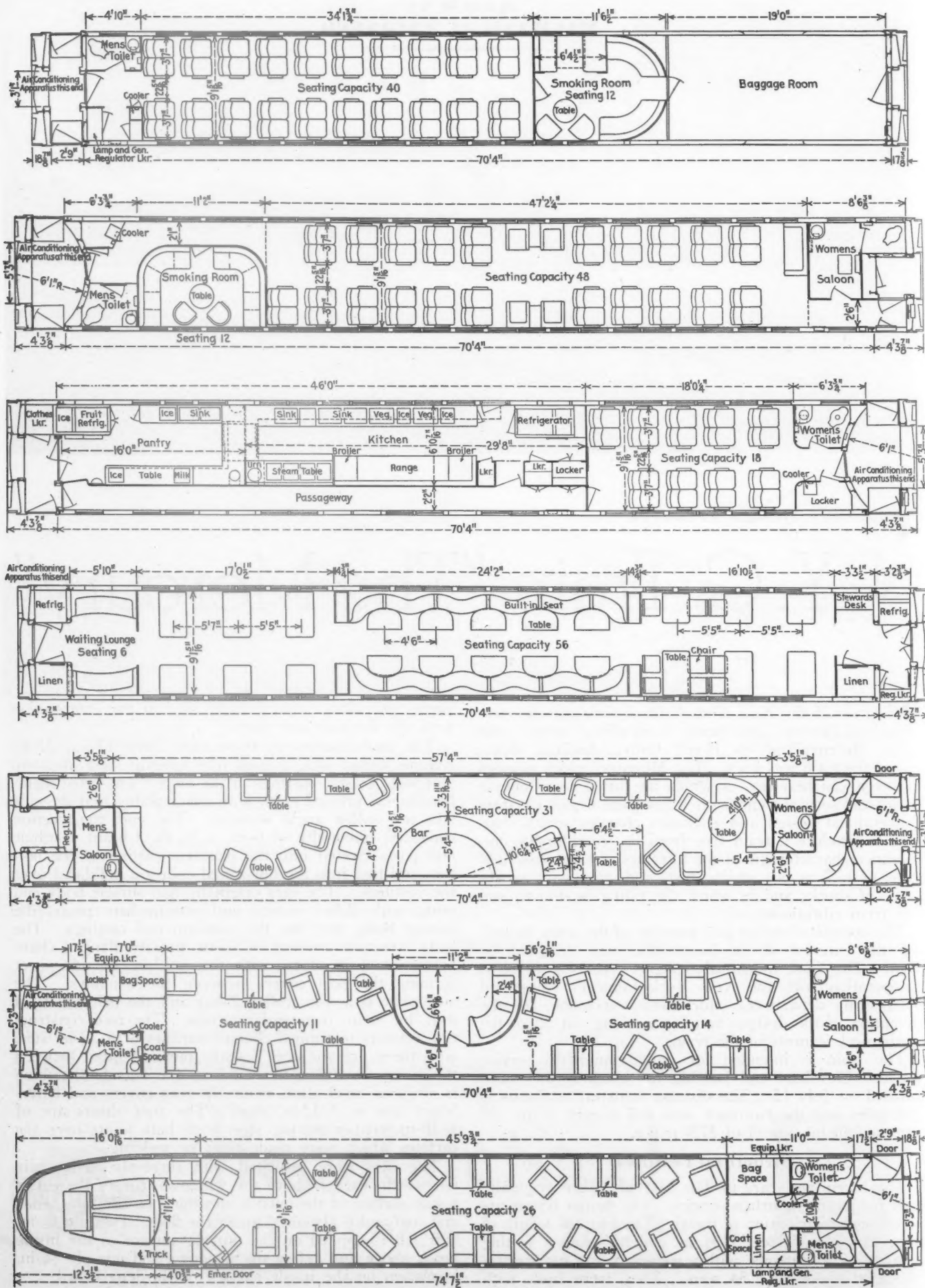
The seven steel cars in The Mercury were originally built for steam suburban service. The design represents an efficient distribution of metal. The coupled length of these cars was 78 feet 11 $\frac{3}{4}$  in. and they had a seating capacity of 96 persons, with a weight, ready for service, of slightly less than 54 tons. They were built with turtle-back roofs and without hoods at the ends, the roof

sheets extending in a straight line to the intersection with the vestibule end sheets.

The underframes of these cars have 12-in., 35-lb. channel center sills, framed into integral steel platform and body bolster castings at the ends. The cross-members are of pressed steel, with cover plates, and the side sills are rolled angle sections. The end construction consisted essentially of 6-in., 12 $\frac{1}{2}$ -lb. I-beam vestibule end posts riveted into the platform casting at the bottom and tied into the horizontal collision bulkhead over the vestibule. The cars originally had similar body end posts with Z-bar corner and intermediate posts, the former being tied into the platform end castings. The body structure consists of  $\frac{1}{8}$ -in. pressed flanged channel posts, 4 in. deep, with the 3/32-in. outside sheet forming the post covers between the windows. The side plate is a 4-in. rolled Z-bar and the belt rail is of 4-in. by  $\frac{3}{8}$ -in. rectangular section. The roof construction consists of flanged channel carlines of 3/32-in. steel with three pressed-steel Z-shape purlines fitted between the carlines. Below the windows the outside sheathing is of  $\frac{1}{8}$ -in. steel plate, while the post covers and letterboard are of 3/32-in. steel. The roof sheets are of 1/16-in. copper-bearing steel with butt joints over the carlines which were made tight by welding.

The cars were insulated with three-ply  $\frac{3}{4}$ -in. hair felt which, except above the windows, covers the entire inside surface of the outside sheathing on the sides, ends and roof and is also used under the floor. Two-ply  $\frac{1}{2}$ -in. hair felt is applied on the outside surface of the inside finish above and below the windows and one-ply  $\frac{1}{4}$ -in. insulation on the inside surface of the letterboard.

In adapting the cars to the new service certain changes



Floor plans of the seven cars of "The Mercury"

were made in both the body and vestibule end construction of some of the cars. At one end of the coach, the kitchen car, lounge car and the first parlor car the vestibule has been closed up and the vestibule space included within the body of the car. No change was made in the vestibule end construction, at these locations the relatively wide end-post spacing of 3 ft. 1 in. in the original cars being considered satisfactory for the new service. In the combination passenger-baggage car at the head end of the train no changes in the end structure were required. The original platform steps were replaced with folding steps in all of the vestibules of the train. These steps, when folded up by the closing of the vestibule trap door, close the space under the vestibule door and form a continuation of the side surface of the car.

All side windows are fitted with double aluminum sash. The outside sash is built in flush with the car exterior and the inside sash is hinged to permit removal for cleaning.

Where the vestibules were closed the alterations involved the removal of the body ends and the addition of a side sill, side posts and floors over the step wells. The collision bulkheads were reinforced throughout the train.

To provide for the observation room at the rear of the second parlor car the entire body structure at the end of the car had to be torn down to the platform casting and rebuilt. The same center construction was retained and reinforced and the body rebuilt with the belt rail dropped  $11\frac{1}{16}$  in. to provide windows with openings 3 ft.  $9\frac{11}{16}$  in. high (vertical projection) and an unusually wide angle of vision. The end of the car is not only curved in form on the horizontal projection, but is also streamline in a vertical plane as well. This presents a rear end with warped surfaces and the problem of windows around the end of the observation room was a difficult one. This has been worked out, however, in such a way as to avoid completely the use of curved glass, the sash being designed to provide a minimum of interference with the vision of the occupants of the observation room.

The Chanarch construction has been retained, but the composition flooring has been replaced with rectangular cork strips laid in the channel recesses. A layer of  $\frac{3}{8}$ -in. slab cork is then cemented in place in the coaches and corridors where a rubber tile surface is used. Where carpets are laid,  $\frac{1}{2}$ -in. slab cork is used with the top surface sanded.

The interiors of the cars have been finished throughout with aluminum, including ceilings, sides and partitions, in the application of which spot welding, riveting and screws have been employed.

The kitchen and pantry walls and the cupboards are stainless steel. The floors are laid with Alcoa floor plate.

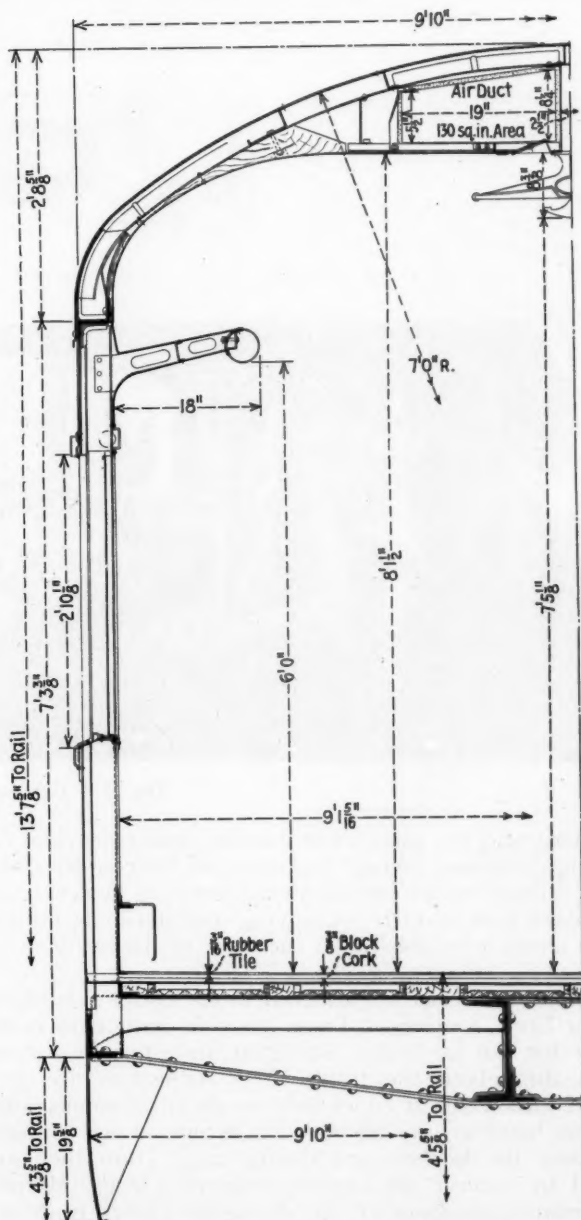
One of the factors in the comfort of passengers is the elimination of diaphragm noise between the cars. This has been accomplished by the use of diaphragms designed and built by the railroad. A patent covering the features of this design has been applied for. The only movement permitted between the diaphragm and the end of the car is the longitudinal compression and the angular movement about a vertical axis necessary to accommodate relative movements of the cars. Lateral movement or torsional movement between cars about a longitudinal axis is taken by the sliding of the lightly loaded face plates on each other.

These diaphragms enclose the entire space between the ends of adjoining cars. The outer surface is formed of sheet rubber.

### The Trucks

With the exception of the kitchen car, the cars are all carried on trucks with the original frames and bolsters. They are of the four-wheel double drop-equalizer type,

with a wheel base of 7 ft. The rolled-steel wheels are 33 in. in diameter, have conical treads and are mounted on 5-in. by 9-in. axles fitted with Timken roller bearings. Because of the added weight of kitchen equipment, the trucks on the combination kitchen-coach have been increased to 8 ft. wheel base and are carried on  $5\frac{1}{2}$ -in. by 10-in. axles, also fitted with Timken roller bearings. The elliptic springs are of high-tensile, chrome-vanadium steel, and the helical springs of silicon-vana-



A half-section through one of the coaches

dium steel. These springs are unusually flexible and contribute materially to the smooth riding qualities of the cars.

The trucks have been fitted with sound-insulating material. Fabreka pads have been placed on both the top and bottom elliptic spring seats and on top of the coil springs. Rubber pads are inserted between the equalizers and the tops of the journal boxes and between the truck frame and wear plates.

The trucks under the kitchen coach are fitted with American type clasp brakes. Those under the other cars are fitted with Simplex clasp brakes. The cars are equipped with New York Schedule UCB air brakes,

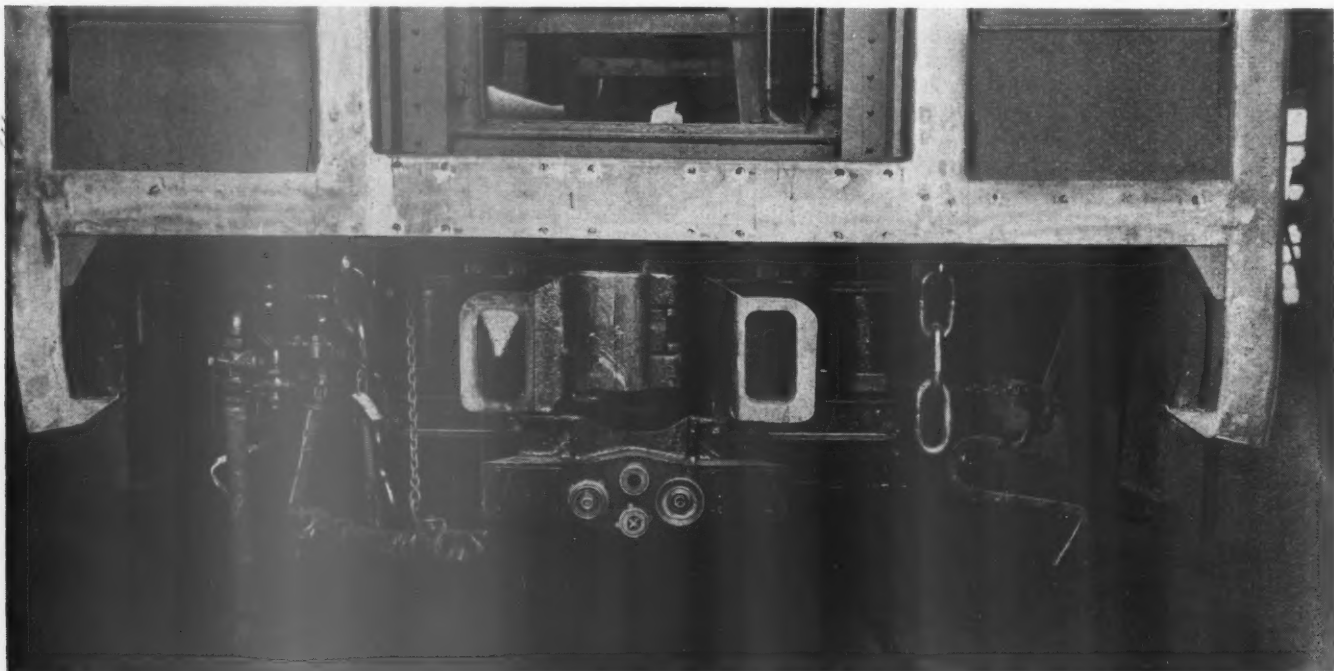
with 16-in. cylinders on all cars except the kitchen car which has an 18-in. cylinder.

#### Connections Between Cars

The rear end of the tender and all of the cars, with the exception of the rear end of the observation car, are fitted with O-B Tight-Lock couplers and Waughmat Twin Cushions and buffers. The Waughmat Twin Cushion without the buffer is installed at the rear end of the train. The rear end of the Tight-Lock coupler shank is fitted with the Ohio Brass type of ball connection which is secured in a socket at the front end of the yoke. This provides a free universal movement between the

movement of the yoke. It is evident, therefore, that with the units operating in opposition to each other the balanced assembly is ready to respond to the slightest change in pressure either in pulling or in buffing, since one set of springs expands and unloads as the other is further compressed and loaded by a buffing or pulling force through the drawbar.

The buffer is provided with light springs in order that the pressure between the diaphragms may not be more than is essential to maintain proper contact between faces under all operating conditions. This pressure amounts to about 1,300 lb. with a compression of  $2\frac{1}{2}$ -in. In addition to the helical springs the buffer includes a



The O-B tight-lock coupler and connector

drawbar and the yoke. The coupler carrier provides for spring-cushioned vertical movement of the coupler shank and is fitted with a lateral spring centering device. The standard type of O-B uncoupling mechanism is utilized with levers accessible under each side of the car near the end.

Connector heads are attached to the under side of the Tight-Lock couplers. These provide automatic couplings for the air-brake, air-signal and steamheat train lines throughout the train. The connectors are provided with wings at either side for electrical connections. These, however, are all blanked, except on the couplers between the kitchen and dining car. Here they are fitted to connect the circuits required for the electro-pneumatic operation of the dining-car doors from the end of the kitchen car.

The Waughmat Twin Cushions at each end of the car are made up of two sets of Waughmat concentric springs of Spencer-Moulten rubber, each set consisting of a series of rubber springs and steel plates held between followers.

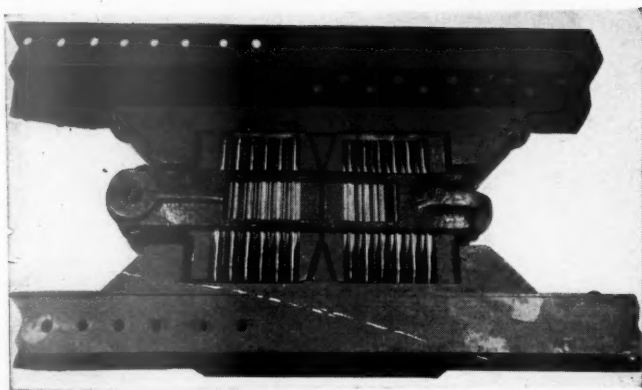
The Twin Cushions operate against abutments located in the center of the pocket with one Waughmat Cushion bearing against the front face and the other against the rear face of the abutment. The front follower of the forward spring assembly and the rear follower of the rear spring assembly bear against the inside ends of the yoke under an installed compression of about 8,000 lb. These, however, are all blanked, except on the couplers and, therefore, move forward and backward freely with

series of Waughmat rubber springs which take the heavy buffing loads after the closure of the steel springs.

#### Interior Facilities

In adapting these cars to the new service the interiors were completely removed and the end structures changed where necessary to close up vestibule side-door and step openings and to accommodate diaphragms which completely enclose the space between the ends of adjoining cars. The train is designed as a complete unit, no two cars being alike in interior arrangement. It provides seats for 106 coach passengers and for 57 persons in the Pullman parlor cars, including six in the parlor-car compartment. There are additional seats for 24 in the two spacious coach smoking rooms. Fifty-six persons may be seated at one time at the tables in the dining rooms, with additional seats for six in a lounge at one end of the diner for those who may have to wait for seats at the tables. A lounge car, with seats for 31 passengers, and an observation room, with seats for 10 persons, are provided for the use of the parlor-car patrons. All seats in the coaches are numbered and coach tickets will be sold up to the seating capacity.

A combination of medium gray, with scratch brush metal trimmings are used on the exterior of the train from the front of the locomotive to the rear end of the parlor-observation car and aluminum panels tie the windows into a single wide band along each side of each car. At night the locomotive running gear is floodlighted



The Waughmat rubber draft gear with a section of the yoke cut away to show its construction

from lamps concealed under the skirt below the running board.

The interior of the train is notable for the variety of architectural treatments employed in the various cars and the way in which a variety of colors has been used. The repetition throughout the train of the colors selected tends to tie the cars together as a unit, although the way in which these colors have been combined varies in the different cars. The colors include tans, browns, musk, rust, bright blue, green, bright red and gray. All the china, silverware and glassware have been designed especially for this train.

The train consists of a combination passenger-baggage car, a coach, a combination kitchen-coach, a dining car, a lounge car with a bar, a parlor car and a parlor-observation car. The coach compartments in the first



The rotunda vestibules are much roomier than usual

three cars all have arched ceilings above the center of which is an air duct of large cross-section. Below the center of the ceiling is supported a wide shallow trough which serves as a diffuser of the conditioned air from the duct above the ceiling and as a reflector of the indirect lighting which furnishes general illumination for the coach interiors.

The under side of the baggage racks is solid and curves into the side wall above the windows. A tubular section at the outer edge of the racks encloses the lights for the individual seat units.

The monotony of the seating arrangement in the second car, which is a full coach, is varied by placing a built-in seat against the bulkhead at the forward end. At approximately the middle of the car on each side

are placed two built-in heavily upholstered chairs with a small ebonized table and a reading lamp between. For contrast with the brown mohair of the slats these chairs are upholstered in blue-green mohair.

At the front end of the coach portion of the combination passenger-baggage car is a smoking room with lounge seats, sections and chairs for 12 passengers. At the rear end of the second coach is another smoking room, with seats for 12. To make it equally available to men and women a glass-enclosed opening extends half way across the bulkhead and along the corridor to the door.

Wall sockets are provided in the coaches for tables at all the seats. Both single and double tables are provided, and they can be used to serve meals at the coach seats.

Because of the relatively short trips, both of which include meal hours, it was necessary to provide facilities for serving quickly a large number of passengers. Hence, an unusually large kitchen and serving pantry occupy about two-thirds of the third car and the fourth car is devoted entirely to dining service, seating 56 persons at one time.

The dining room is divided into three sections. The end sections have the customary arrangement of tables and chairs. The middle section is fitted with built-in leather upholstered seats with the backs against the sides of the car and semi-circular tables for two facing on the aisle. The sides and ends of this car are finished throughout in plain quartered walnut Flexwood with the grain running vertically. The ceilings in the end sections are horizontal with a shallow, flat clerestory recess at the center, finished in buckskin tan. Through openings in the sides of the clerestory recess conditioned air enters the car. The lighting is of the louver type, the units being placed transversely across the lower ceiling level over each table location on either side.

In the center section of the dining room the ceiling, also finished in buckskin tan, is carried down in a sweeping curve to the tops of the windows. Below the center of the ceiling, in a wide band of blue, is an air diffuser and indirect lighting fixture somewhat similar to those in the coaches. The seats in this room are upholstered in blue to match the wide band in the middle of the ceiling. The floor throughout the car is covered with carpet with a broken stripe pattern in two tones of rust.

The three sections are separated by double partitions about a foot apart, having clear plate glass above the wainscoting. Between these glass walls on each side of the aisle provision has been made for blooming plants or cut flowers, illuminated by special ceiling fixtures.

The kitchen is 29 ft. 8 in. long and the pantry at the end of the car adjoining the dining car is 16 ft. long. The pantry opens through double doors into a vestibule at the end of the car which is separated from the corridor alongside the kitchen by a door. There is no provision for closing this vestibule at the end of the car. The end of the dining car, however, is closed with double swinging doors, operated electro-pneumatically by an electric eye mounted on the end posts of the kitchen car. Push plates which can be readily operated by the elbow are provided at the end of the kitchen car for alternative use and in the dining car to operate the doors when returning to the kitchen.

A service door is provided at the kitchen side of the car near one end of the kitchen and at the vestibule on the opposite or corridor side.

The car back of the diner is entirely devoted to lounge facilities. In the middle, against one side, is a semi-circular bar backed up by mirror panels extending from the top of the bar to the ceiling, which gives the impression of increased width to the car. Heavily upholstered

loose chairs, built-in settees and sections are conveniently arranged on either side of the bar.

The walls of the parlor cars are finished in walnut Flexwood down to the wainscoting, which is natural cork, of the same tone. The chairs, although generally similar in form, have been upholstered in a variety of colors and fabrics. There are rectangular lamp tables in walnut and movable circular tables having black Formica tops, with Alumilite metal bases, and trim. The lighting of the parlor cars is provided by troughs along the sides placed at the base of the ceilings. These are arranged to provide indirect lighting from the ceilings and direct reading light at the chairs through louvers at the bottom.

In the first parlor car the outside walls of the semi-circular compartment in the middle of this car are finished with a photo-mural in cloud effect. The location of the compartment itself and the possibility for some variation in the arrangement of the loose chairs relieves the corridor-like effect of a long, unbroken interior.

The observation room at the rear of the second parlor car represents a marked departure from the customary arrangement of such compartments in two respects. Instead of arranging chairs about the sides of the room a fixed center settee has been built in with seats for three persons on each side facing toward the windows and with seats for two persons at the rear end facing directly toward the windows in the end of the car. Two additional chairs are provided, one at each side against the glass partition which separates this room from the main compartment of the car, both thus facing toward the rear. The other respect in which this room departs from American custom is in the lowering of the window sills approximately one foot below the standard height throughout the rest of the train.

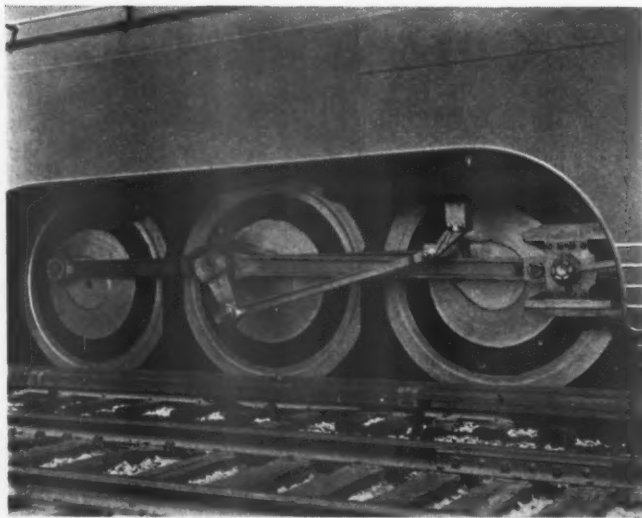
A roomy bag locker is provided in each of the two rear cars. These lockers, fitted with deep shelves, provide for the checking of hand luggage by the porter. The lockers are closed by a roller curtain of aluminum. Across the aisle from each baggage locker is a recess fitted with hangers for the storage of coats or wraps.

With the exception of the dining car, which has none, there is a single vestibule at one end of each car. Those in the second and third cars and in the two parlor cars adjoin each other and in each case have been treated so that, together, they form an unusually spacious lobby between the cars.

In carrying out this scheme the vestibule end posts have been changed to give a clear passage between cars of 5 ft. 3 in. and the body ends have been replaced with walls built on a circular arc. The effect is to create a rotunda from which open the vestibule side doors and the doors into each car. The vestibule at the front end of the club car, next to the diner, is similarly treated, except that because of the absence of an adjoining vestibule, the spacing of the end posts was not changed from the original of 3 ft. 1 in. The vestibule at the rear end of the first car is of conventional form.

### Lighting

The beauty of the train is greatly enhanced by the lighting system, which performs the dual function of serving as decoration and also giving adequate, well-distributed illumination. The overhead lighting in the main sections of the first three cars consists of continuous indirect ceiling fixtures. A row of 15-watt lamps on 10-in. centers along the ceiling is screened from view by a continuous suspended baffle which reflects light to the ceiling. An opening along the center of the baffle permits light to escape downward to a secondary baffle, which illuminates the bottom of the upper structure, and at the same time re-directs the air from the air-conditioning system.



The driving wheels are finished in aluminum and black and are illuminated at night

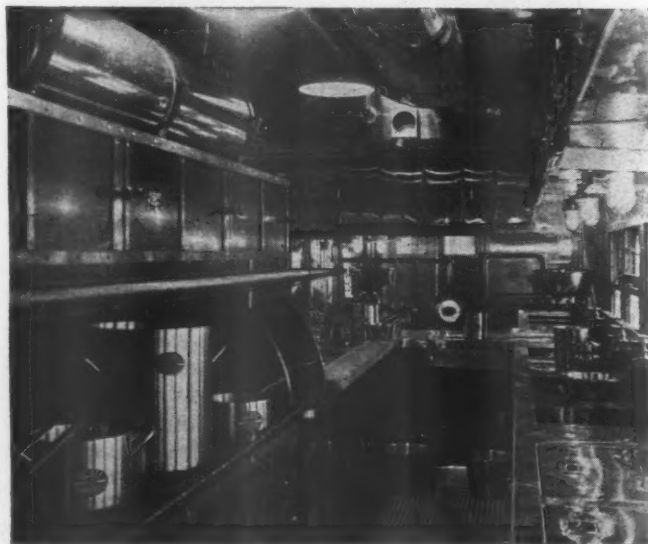
Reading light for seated passengers in the main sections of these cars is supplied by baggage-rack fixtures. The units are located in a tube forming the outside roll edge of the baggage rack, with a 60-watt T8½ lamp over each seat. Transverse louvers at the bottom of the fixture protect the passenger from direct view of the light sources. Each light is controlled individually by a toggle switch.

The baggage compartment of the first car is lighted by three 50-watt and one 25-watt ceiling fixtures. The smoking room in this car receives light from two 50-watt and four 25-watt fixtures. These are located in an air-diffuser plate.

In the kitchen and pantry sections of the kitchen car, vapor-proof units are used. There are nine 50-watt and eleven 25-watt units.

In the center section of the dining car, two continuous indirect lighting troughs are installed. These units include 80, 15-watt lamps on 7-in. centers. The end dining sections are lighted by louvered flush diffusing panels, which extend from the side wall to the raised center portion of the ceiling. There are 12 of these units, each equipped with one 25-watt and one 50-watt lamp.

The semi-circular bar in the lounge car is lighted by



Interior of the kitchen



Interior of second coach showing one of the murals

eight 25-watt lens-type units, which direct a strong light downward onto the bar. Indirect illumination is also provided inside the bar by means of twelve 10-watt lamps mounted in a semi-circular trough suspended just below the ceiling. The semi-circular row of direct

#### Light Weights of the Cars of The Mercury

Passenger baggage car.....	125,240 lb.
Coach car.....	126,100 lb.
Kitchen-coach car.....	148,520 lb.
Dining car.....	123,280 lb.
Lounge car.....	124,320 lb.
Parlor car.....	123,700 lb.
Observation-parlor car.....	122,260 lb.

lighting units and the indirect fixture are reflected in the mirror back of the bar to give the illusion of complete concentric circles. The sections on either side of the bar are more softly illuminated by continuous inverted trough, direct units, fitted with 132 10-watt S-11 lamps on 10-in. centers. The under side of the trough is fitted with transverse louvers, which direct the light downward and conceal the lamps. The side louver lighting is augmented by the two circular louvered ceiling units, one at either end of the car. These are each equipped with one 100-watt lamp.



Looking forward from the observation room

In the summer when lighting requirements are at a minimum and power is required for air conditioning, the 25-watt lamps in the louvered fixtures will be replaced with 15-watt lamps. When these are used, the lighting intensity on the 45-deg. reading plane is 6 foot candles. In this way the large air-conditioning generators are used in off season to provide high lighting intensities which are more desirable, especially in the winter months.

The wide vestibules are lighted by two 25-watt and one 50-watt lens-type units. An intensity of  $4\frac{1}{2}$  foot candles is obtained at the edge of the platform and  $2\frac{1}{2}$  foot candles on the bottom step. Lens-type units are also used as locker lights and passageway lights at many locations throughout the train.

General lighting in the men's and women's saloons is supplied by one or two lens-type units. The mirrors in these rooms have horizontal recessed reflectors at the top and bottom, fitted with 30-watt Lumiline lamps. Three of the women's rooms are also equipped with built-in vanity table fixtures.

Four vertically-mounted fixtures, each containing two 30-watt Lumiline lamps, are used to light the waiting lounge at one end of the dining car.

Sixty-volt Mazda lamps are used throughout the train. This is a special rating, the 60-volt, rather than 64-volt lamps being chosen to insure that the lamps burn at full brilliancy when they are receiving their power from the battery, when the generator is not running.

Back-up and marker lights are built into the rear of the parlor-observation car, the latter having a mechanism for changing colors. The rear sign is lighted by seven 25-watt lamps, arranged in two rows.

Circuit breakers are used to protect and control lighting circuits. Toggle switches are used for individual lights. Door switches are used in lockers having lights and in refrigerators.

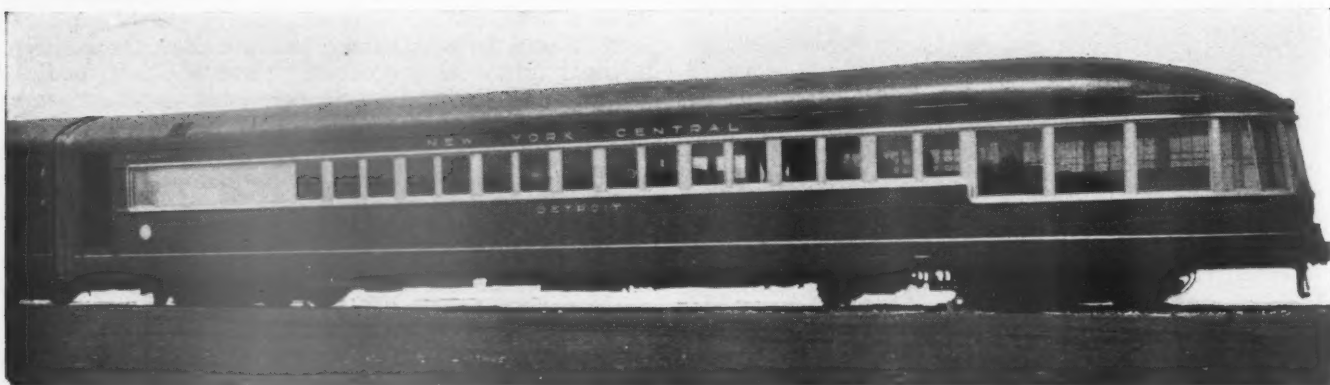
#### Air Conditioning

All cars are air-conditioned throughout for year-round operation, the electro-mechanical system being used. Each car is supplied with a 6-ton Frigidaire compressor, driven by a 15-hp. a.c.-d.c. motor mounted under the car. The evaporator with blower and intakes is placed in the ceiling at one end of the car. The blower is driven by a  $\frac{3}{4}$ -hp. motor. The re-circulated air intake is located in the passageway ceiling. Outside air intakes are placed in the ceiling of the vestibules, except in the dining car, where the outside air intake is placed in the vestibule end construction.

Air distribution has been worked out, so that ducts and other passages are concealed and combined with lighting fixtures, in such a way as to provide the desired circulation without interference with the interior appearance or decoration scheme. Exhaust fans are provided, one in each of the toilets and the smoking rooms in the passenger baggage car and coach; the compartment in the parlor car, the stewards section and the regulator locker of the dining car and the pantry of the kitchen coach. Two are provided in the kitchen of the kitchen coach and the observation section of the parlor-observation car. These fans insure proper ventilation without permitting the infiltration of outside air. Two motor-driven blowers supply draft for the range.

Other motor-driven equipment includes a kitchen mixer with accessories, including a juice extractor used in the kitchen and a drink mixer used at the bar.

Each car is equipped with a 20-kw., 80-volt, body-hung generator, driven from an axle through a Spicer positive gear drive having a ratio of 2.54:1. There are two 16 cell, 600-amp.hr. lead batteries, connected in series, per car. Standby power can be received both as 220-volt, three-phase, a.c. power for operating the com-



The streamlining at the rear of the train

pressor motors and as 80-volt, direct-current power for charging batteries. There are two d.c. and two a.c. receptacles on each car, one set on each side.

### The Locomotive

The locomotive, which by its streamlining and decoration is an integral part of the train, is a K5 Pacific type locomotive of a design developed in 1926. It develops a maximum tractive force of 37,600 lb. The cylinders

are 25 in. in diameter by 28 in. stroke; the driving wheels, 79 in. in diameter, and the boiler pressure, 200 lb.

The principal dimensions of the locomotive are given in tables accompanying the text.

## U. P. to Build First Steam Turbine Electric Locomotive

The first steam turbine electric locomotive to operate on an American railroad will be constructed by the Union Pacific and the General Electric Company, this action being one of the first developments of the recently formed research department of the railroad. The locomotive will consist of two 2,500-hp. self-contained units, which can be operated individually or in synchronization and will be capable of a maximum speed of 110 m.p.h. with a trailing load of 1,000 tons. Delivery is expected early in 1937. The design of the locomotive is such that by operating both units it will be possible to maintain the schedules of the Los Angeles Limited, The Challenger or other limited trains in transcontinental service. With either unit it will be possible to maintain the schedule of the Streamliner City of Denver.

The weight of the new locomotive will be approximately 20 per cent less than that of a conventional steam locomotive, and lighter than the Diesel-electric locomotives now used on Union Pacific streamliners. It will use fuel oil of approximately the same grade as that used for the conventional oil-burning steam locomotives and will also be equipped to use distillate.

Each of the units will be of the 4-6-6-4 type, the size of the wheels being 36 in.-45 in.-45 in.-36 in., respectively. The locomotive will have fuel and water capacity for continuous operation for a minimum of 550 miles without refueling. The steam turbine of each unit will be connected directly to a 225-kw., three-phase, 60-cycle, 220-volt generator, which will provide electricity for the six traction motors, one of which will be mounted on the axle of each pair of the six driving wheels on each unit.

GET OFF AND PUSH—W. G. Besler, chairman of the board of the Central of New Jersey, sends in a reproduction of a ticket issued by the Elizabethtown & Somerville about 1848, which contains the following provision: "The passenger to assist the conductor on the line of road whenever called upon." Mr. Besler also recalls that an old-timer once informed him that, on rainy days on a summit on the Chicago, Burlington & Quincy in Missouri, it was the regular practice to require all male passengers to stand on the car steps going over the hill and, if the locomotive stalled, it was their duty to hop off and push.

### General Dimensions and Weights of the New York Central "Mercury" Locomotives

Railroad	New York Central
Builder	American Locomotive Co. (Streamlined at N.Y.C. West Albany shops)
Type of locomotive	4-6-2
Rated tractive force, engine, 85 per cent, lb.	37,600
Weights in working order, lb.:	
On drivers	193,800
On front truck	66,300
On trailing truck	56,900
Total engine	317,000
Tender	292,300
Wheel bases, ft. and in.:	
Driving	13-8
Engine, total	36-11
Engine and tender, total	79-5½
Driving wheels, diameter outside tires, in.	79
Cylinders, number, diameter and stroke, in.	2-25 by 28
Valve gear, type	Walschaert
Boiler:	
Steam pressure, lb.	200
Diameter, first ring, inside, in.	79½
Firebox, length, in.	108½
Firebox, width, in.	90¼
Tubes, number and diameter, in.	190-2¼
Flues, number and diameter, in.	45-5½
Length over tube sheets, ft.	21
Fuel	Bituminous coal
Grate area, sq. ft.	67.8
Heating surfaces, sq. ft.:	
Firebox	222
Arch tubes	35
Firebox, total	257
Tubes and flues	3,695
Evaporative total	3,952
Superheating	1,150
Combined evaporative and superheating	5,102
Tender:	
Style	Cast-steel frame
Water capacity, U. S. gal.	15,000
Fuel capacity, tons	16
Trucks	Six-wheel

are 25 in. in diameter by 28 in. stroke; the driving wheels, 79 in. in diameter, and the boiler pressure, 200 lb.

This locomotive was refitted at the West Albany shops, at which time the drivers were replaced with wheels of the Boxpok type, and the entire locomotive and tender fitted with a streamline cowling to harmonize with the exterior of the coaches. The driving-wheel centers have been painted in aluminum. A band of black separates the central aluminum discs from the aluminum finished rim and tire.

The lighting on the running gear of the locomotive is supplied by three 50-watt and two 15-watt lamps on either side, located under the cowling immediately above

# Front-End Arrangement\*

A PROPOSED new standard method of drafting steam locomotives, based on a proper proportioning to each other of the gas areas over the brick arch and throughout the smokebox is indicated on the proposed recommended practice, Sheets 1 and 2. Employing the same general arrangement of the smokebox details and adhering basically to the design known as the "Master Mechanics" front end, as described in the 1906 Proceedings of the American Railway Master Mechanics Association, the proposed method has been developed from an analysis of data secured from standing and road test results while redrafting various classes of bituminous coal burning locomotives of conventional design in a wide variety of service and using all the common kinds and mixtures of bituminous coal.

The details of the smokebox and arrangement of the "Master Mechanics" front end design consist of an exhaust stand with round-bore exhaust nozzle, smokestack and stack extension bolted together, a diaphragm plate or vertical back deflecting plate, a table plate supported by the exhaust stand and attached to the diaphragm plate and sides of the smokebox, an adjustable draft sheet attached to the table plate, and smokebox netting attached to the table plate and the interior of the smokebox and usually applied in a sloping position.

From a study of the gas areas of properly drafted locomotives and observations made while redrafting, it was discovered that there is a definite and necessary relation of these areas to each other and that this relation is practically identical on all the locomotives redrafted. It has been considered logical therefore, to use one of these areas, namely, the minimum net gas area through the tubes and flues, as an index to which the other gas areas, including the minimum area of the smokestack, should be compared and proportioned.

Comparison of stack diameters determined by the method recommended with the diameters of existing stacks or stack diameters determined by other methods in general use discloses in a majority of cases that larger stacks may be used. The use of larger stacks permits the use of larger exhaust nozzles with subsequent reduction in back pressure. Reduction in back pressure, when accompanied by satisfactory steaming qualities and fire conditions, results in a saving of fuel. Other advantages of reduced back pressure are increased drawbar pull and a reduction in the maintenance costs.

While this discussion is devoted particularly to redrafting existing locomotives, the method outlined is equally applicable to new locomotives, and the designs for brick arch and smokebox details of a new locomotive may be developed in accordance with the plan as soon as the minimum net gas area through the tubes and flues is known.

As the principles and method of drafting recommended have been gathered from tests made with locomotives equipped with grates having 20 to 30 per cent effective air opening, it is possible that minor changes in some proportions may be necessary to obtain satisfactory results when drafting locomotives having grates with net air opening not within these limits. The recommended

## Successful method for redrafting locomotives by modification of Master Mechanic's front end

practice will, however, serve as a guide and such changes in proportions as may be found necessary as a result of tests should then be made a part of the method.

Fig. 1 illustrates the recommended arrangement of smokebox details, with recommended gas areas and other pertinent data. Fig. 2 illustrates the recommended brick arch design, together with recommended net area of the opening between the back end of the arch and the crown-sheet.

The following paragraphs and included diagrams cover the design of the various smokebox details and include a discussion of the analysis of gas areas, gas passages in the smokebox, assembly of smokebox details, study of the drafts and tests to determine locomotive and fuel performance.

### Analysis of Smokebox and Firebox Design

When preparing to redraft a locomotive or make changes to improve steaming qualities, the first step is to calculate and tabulate actual gas areas. These may be calculated in square inches and are as follows:

- 1—Net area between top of brick arch and crown-sheet at rear end of arch.
- 2—Minimum net gas area through tubes and flues.
- 3—Maximum area under table plate.
- 4—Minimum net area under table plate (opposite exhaust stand and steam pipes).
- 5—Area under draft sheet.
- 6—Net area through smokebox netting.
- 7—Area of smokestack at minimum diameter.

In tabulating the gas areas a graphical chart such as Fig. 3 is recommended. The minimum net gas area through the tubes and flues is used as the base for plotting the other areas and is rated at 100 per cent. A percentage tabulation of the other areas is also given.

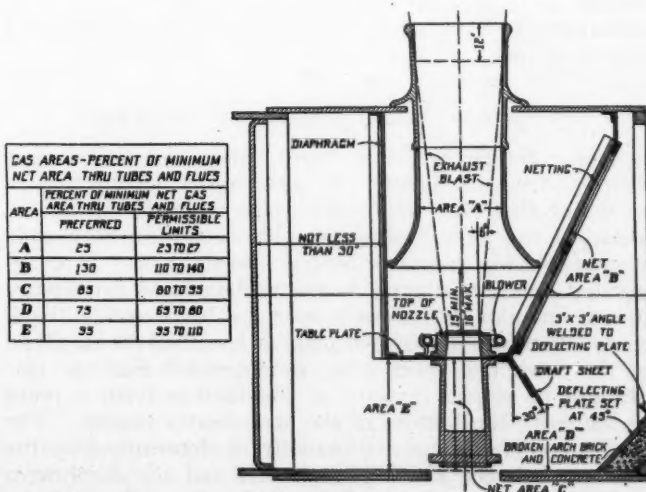


Fig. 1—Smokebox arrangement

\* Abstract of a sub-committee report included in the general report of the Committee on Locomotive Construction at the meeting of the Mechanical Division of the A.A.R., Chicago, June 25 and 26, 1936.

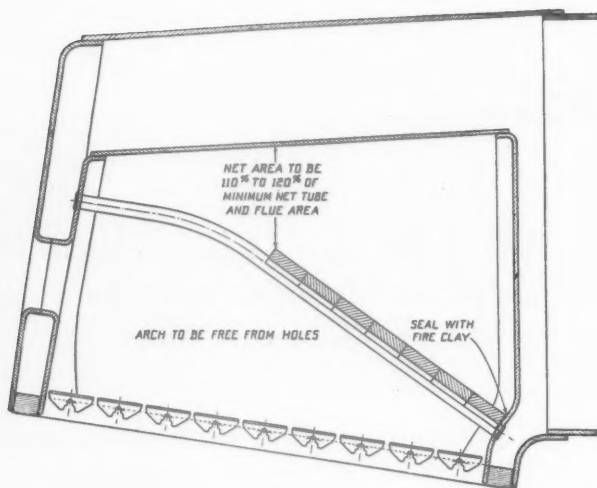


Fig. 2—Brick arch arrangement

Each chart should carry such important data as locomotive classification, size of stack, etc. A typical group of actual gas areas for a U. S. R. A. Mikado type locomotive are shown in Fig. 3.

#### RECOMMENDED GAS AREAS

Recommended gas areas are illustrated in Fig. 4 as a percentage of the minimum net gas area through the tubes and flues. The areas shown form the basis of the proposed new method of drafting and have been successfully employed in redrafting several hundred locomotives. Many new locomotives drafted to these proportions have been placed in service and operated under varying conditions without any change in smokebox details.

In Fig. 4 there is a gradual stepping down in the preferred areas from the area over the arch to the area under the draft sheet. While this condition is ideal it will be found necessary in some cases to have the maximum area under the table plate somewhat in excess of the minimum net gas area through the tubes and flues in order that the minimum area under the table plate shall not be less than under the draft sheet. Where this condition exists it has been found that the draft sheet loses most of its value as a regulator of the drafts.

Application of the recommended proportions to the locomotive for which the actual gas areas are tabulated in Fig. 3 permitted an increase in stack diameter from 17 in. to 20 in. This, in turn, made it possible to increase the exhaust-nozzle diameter from 7 in. to 8 in. with entirely satisfactory results and with a substantial saving in fuel.

#### IMPORTANT GAS PASSAGES IN SMOKEBOX

**Space Between Front Flue Sheet and Diaphragm Plate.**—Not infrequently on some older locomotives it is found that the diaphragm plate is less than 30 in. ahead of the front flue sheet. This condition is usually responsible for excessive heat at the firedoor. In exaggerated cases the flames in the firebox have a tendency to roll and not move freely over the brick arch. In all cases where the diaphragm plate is less than 30 in. ahead of the front flue sheet it is recommended that the diaphragm be sloped forward at the bottom from a point in line with the bottom of the superheater header. The total amount of slope will usually be determined by the distance between the exhaust stand and the diaphragm and should not exceed 15 in. Where the flare of the smokestack interferes with obtaining the desired slope in

the diaphragm a small portion may be cut off the flare without harmful effects. The portion of table plate projecting backward beyond the new location of the diaphragm plate should be cut off as shown in Fig. 5. On some modern locomotives a reverse condition is encountered and the diaphragm plate is an excessive distance from the front flue sheet. With smaller locomotives this may be responsible for difficulty in obtaining sufficient draft. Where such an effect is recognized it has been found helpful to install an additional diaphragm plate in back of the existing plate and approximately 36 in. ahead of the front flue sheet. The table plate should be extended over to the extra diaphragm and the compartment thus formed made air tight. See Fig. 6. The superheater damper is located in the passage between the front flue sheet and diaphragm plate. Some roads have removed all superheater dampers while others have retained them. It is not intended to approve or criticize either practice. However, it has been noted that drafting of locomotives by the method described has

LOCOMOTIVE CLASS.....  
STACK DIAMETER—MINIMUM..... 17"  
DRAFT SHEET HEIGHT ABOVE BOTT OF SMOKE BOX..... 17"  
NUMBER OF ARCH BRICKS IN SIDE ROWS..... 6  
NUMBER OF ARCH BRICKS IN CENTER ROWS..... 6

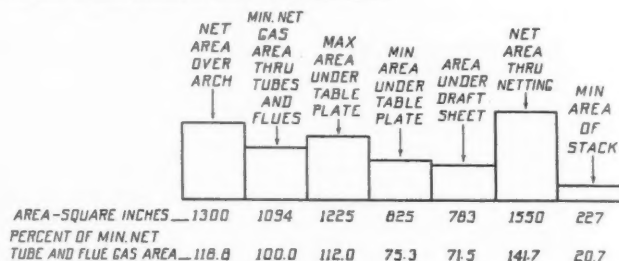


Fig. 3—Actual gas areas, U.S.R.A. Mikado locomotive

been more successful when dampers have been removed. All accompanying diagrams have been prepared on that basis.

**Space Between Diaphragm Plate and Back of Stack.**—The space in back of the stack may also be excessive, although this is not as likely to be responsible for poor steaming as excessive space behind the diaphragm. On smaller power, however, if the diaphragm is more than 12 in. behind the back side of the stack some improvement may be noted if an additional diaphragm plate is applied as close to the stack as possible. The compartment thus formed should be made air tight. See Fig. 7.

**Space Between Front Edge of Draft Sheet and Smokebox Front.**—The space between the front edge of the draft sheet and the smokebox front is very important, and in no case should the area between the draft sheet and the smokebox front be less than the area under the draft sheet. It is preferred to have the table plate extend forward from the center of the exhaust stand as little as possible, providing only sufficient plate to attach the smokebox netting and the draft sheet.

**Space Below Table Plate.**—Too much attention can-

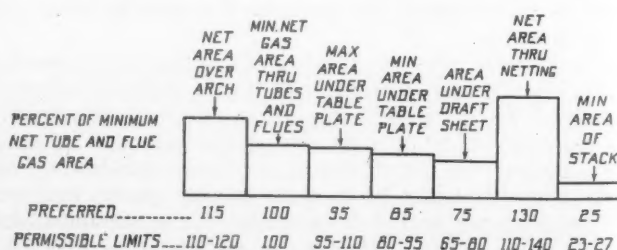


Fig. 4—Recommended gas areas

not be given to keeping the space below the table plate free from any obstructions which may hinder the free flow of gases from the firebox. The presence of large pipes, such as the booster exhaust or pipes connecting the exhaust stand or exhaust passages of the cylinder to the feedwater heater, particularly when located on the floor of the smokebox, are bound to set up eddies in the flow of gases and may be responsible for undesirable fire conditions and poor steaming. The injurious effects of these pipes may exist even though the net area under the table plate, deducting the areas of the pipes, may be well within the recommended limits. Every attempt should be made to remove these pipes from the smokebox entirely. If it is impractical to do this, the pipes should be applied directly under and close to the table plate or placed in line with the exhaust stand in order to offer as little resistance as possible to the gas flow. In some cases the main steam-pipe casings within the smokebox are unnecessarily large, making it difficult

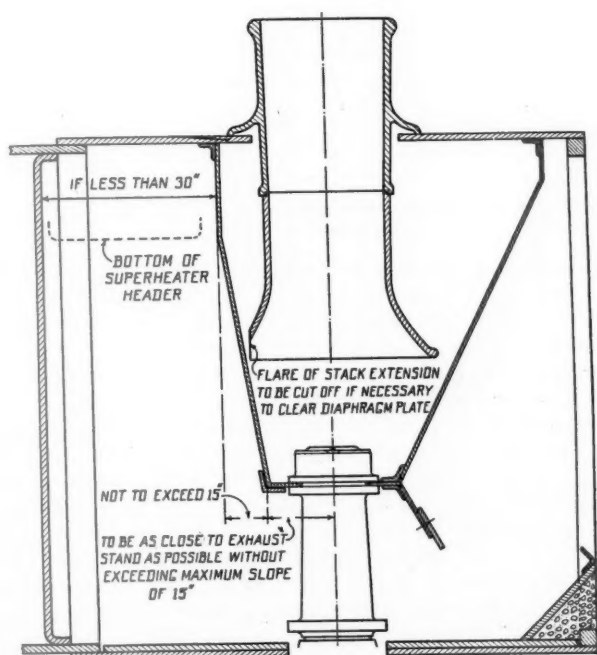


Fig. 5—Sloped diaphragm plate should be used when diaphragm is less than 30 in. ahead of flue sheet

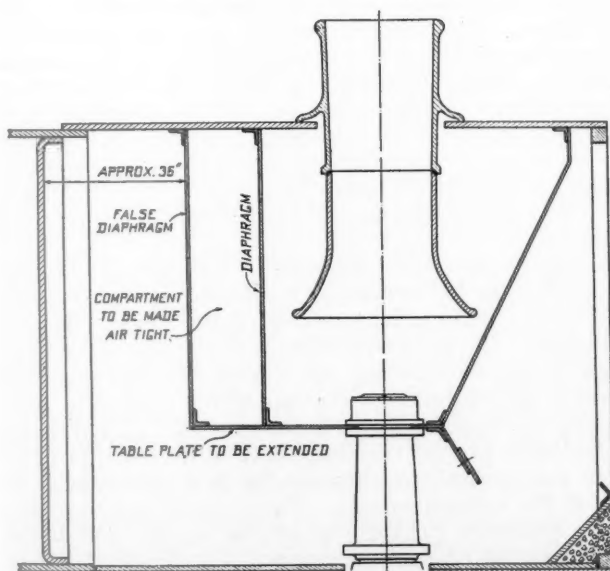


Fig. 6—Application of false diaphragm to reduce excessive smokebox volume behind diaphragm

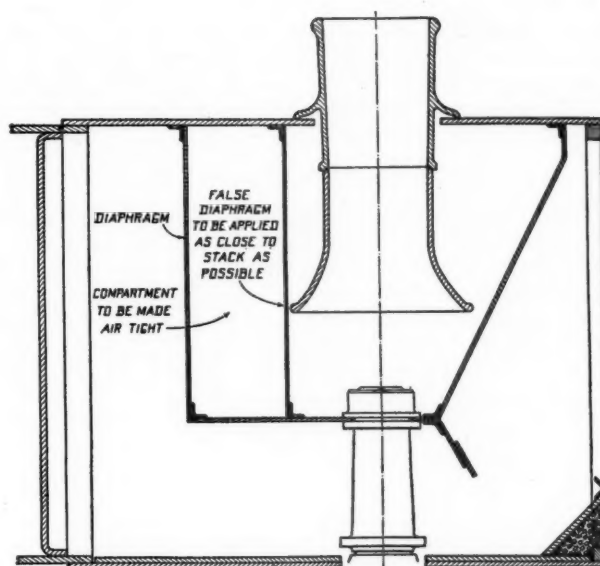


Fig. 7—Application of false diaphragm to reduce excessive smokebox volume between stack and diaphragm

to obtain the recommended minimum area under the table plate. Extra large steam-pipe casings may also have an undesirable effect on the fire by creating eddies in the flow of gases from the firebox. When these conditions exist it is recommended that the size of the steam-pipe casings be reduced in order to secure the desired minimum area rather than raising the table plate. In no case should the minimum area under the table plate be less than the minimum recommended on Fig. 1.

#### DESIGN OF BRICK ARCH

The importance of the brick arch construction is emphasized since it plays a most important part in the combustion process. The net area over the arch at the rear end should be within the limits recommended in Chart 2 in order to provide ample space for the passage of the gases of combustion and yet confine the stack loss to a minimum. Care should be taken to see that the arch is free from holes. For best results the arch should be sealed at the throat sheet. The use of "Toe" brick at the throat sheet is usually accompanied by and accountable for excessive stack loss, smoke and unequal draft distribution.

#### Recommended Design of Smokebox Details

##### SMOKESTACK

The diameter of the smokestack will be obtained from Fig. 4 using that dimension which, in even inches, provides an area closest to that recommended. This should be the minimum diameter at the choke.

A two-piece smokestack, consisting of the stack proper and stack extension, is recommended. The stack proper should have a tapered bore throughout its length, the taper being 1 in. in diameter in 15 in. of length. While this taper is preferred, satisfactory results may be obtained with stacks having a taper of 1 in. in diameter in 12 in. of length. It is recommended that the stack taper be kept within these limits, namely 1 in. in diameter in 12 in. to 15 in. of length. Where the design permits, it is recommended that the entire length of the stack proper be made 30 in.

The stack extension should have a parallel bore equal to the minimum bore of the stack and end in a flare 28 in. to 32 in. in diameter, depending on the size of the stack. The flare should be approximately 15 in. in length and designed with a long sweeping curved surface.

## EXHAUST STAND

30" PREFERRED

TAPER IN DIA IN 15"

AREA TO BE 25%  
OF MIN. NET TUBE  
AND FLUE AREA

18" R.

15"

TO SUIT

26" FOR STACKS 16" DIA. AND UNDER  
32" FOR STACKS OVER 16" DIA

**Fig. 8—Smokestack and extension**

In some cases the supply of exhaust steam for the feedwater heater is taken from the exhaust stand. This practice is not recommended as it affords an additional source of steam leaks within the smokebox. Furthermore, the pipes for conveying exhaust steam to the heater, when applied below the table plate, often offer serious restriction to the free flow of gases. It is much preferred that these pipes be connected to the exhaust passages of the cylinders and connected with the feedwater heater either entirely outside of the smokebox or in depressions built into and sealed from the smokebox.

### EXHAUST NOZZLE

Diagram illustrating the exhaust nozzle and stand assembly, showing dimensions and construction details.

**Exhaust Nozzle Details:**

- Top view shows a circular nozzle with a central bore.
- Side view shows the nozzle with a central bore diameter labeled **A**.
- Dimension **A** is specified: **DIA A TO BE NOT LESS THAN  $\frac{1}{8}$ " GREATER THAN BORE OF EXHAUST NOZZLE**.
- Bottom view shows the nozzle with a central bore.

**Exhaust Stand Details:**

- Top view shows a rectangular stand with four mounting holes.
- Side view shows the stand with a central bore diameter labeled **A**.
- Dimension **A** is specified: **5" MAX 4" MIN**.
- Bottom view shows the stand with a central bore.

**Exhaust Blast Details:**

- Top view shows the exhaust blast with a central bore diameter labeled **A**.
- Side view shows the exhaust blast with a central bore diameter labeled **A**.
- Dimension **A** is specified: **5" MAX 4" MIN**.
- Bottom view shows the exhaust blast with a central bore.

**Method of Determining Nozzle Bore:**

- Top view shows the nozzle with a central bore diameter labeled **A**.
- Side view shows the nozzle with a central bore diameter labeled **A**.
- Dimension **A** is specified: **5" MAX 4" MIN**.
- Bottom view shows the nozzle with a central bore.

**Fig. 9—Exhaust stand, exhaust nozzle and method of determining the nozzle bore**

In determining the correct bore of the exhaust nozzle the theoretical shape of the exhaust steam blast and the point on the stack bore at which it is desired to have the exhaust blast make its "seal" must be taken into consideration. It has been found by tests with round-bore exhaust nozzles equipped with square-bar cross spreaders that the exhaust steam leaves the nozzle at an angle of approximately 6 deg. when exhausted at normal working back pressures of 8 to 10 lb. It has also been observed that best results are obtained when the theoretical "seal" of the exhaust steam jet with the bore of the stack is at a point approximately 12 in. below the top of the stack.

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When making changes in the bore of the exhaust nozzle to improve steaming qualities, it is suggested that increases or decreases in the bore be made in increments of  $\frac{1}{4}$  in. with nozzles of 8 in. bore and over. For nozzles under 8 in. bore the changes should be made in increments of  $\frac{1}{8}$  in.

#### EXHAUST NOZZLE SPREADER

In the course of the tests made while redrafting locomotives various types of exhaust-nozzle spreaders or bridges were tried. These included the square-bar cross spreader, the basket bridge, the single-bar spreader, and the Goodfellow prongs. Tests were also made with an open nozzle, but without notable success except on yard engines in comparatively light service.

By far the most satisfactory results were obtained with the square-bar cross spreader, and this type is recommended. In making the square-bar spreader the diagonals of the cross section of the bar are perpendicular and horizontal. The recommended design is shown in Fig. 10.

The size of the bar to be used for the spreader depends largely on the size of the nozzle, although there is no fixed rule on this. Based on the nozzle bore, the suggested sizes of the bar for cross spreader are as follows:

Nozzle Bore	Size of square bar for cross spreader
5 in. to $6\frac{1}{4}$ in.	$\frac{3}{8}$ in.
7 in. to $7\frac{1}{4}$ in.	$\frac{7}{16}$ in.
8 in. to $8\frac{1}{4}$ in.	$\frac{1}{2}$ in.
9 in. and above.	$\frac{5}{8}$ in.

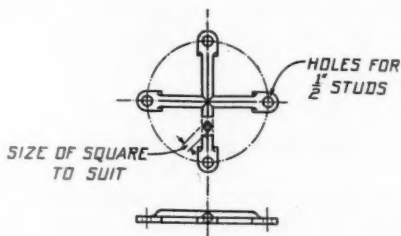


Fig. 10—Cross spreader

Where satisfactory steaming qualities and fire conditions can be obtained by so doing, it is recommended that the cross spreader rest on top of the nozzle. However, in the course of drafting certain locomotives it may be found that improvement in the fire conditions can be made by setting the bottom edge of the cross spreader  $\frac{1}{8}$  in. or  $\frac{1}{4}$  in. below and into the top of the nozzle. Likewise, in some cases it may be found that a change in the size of the bar in the spreader will prove of benefit.

#### BLOWER

In many instances too little attention has been given to the blower design, although the blower is used innumerable times and for indefinite periods during each day's service of the ordinary locomotive. An inefficient blower is wasteful of fuel as well as being unsatisfactory as a draft producing device.

Because of its effectiveness in filling the stack and creating draft, and because of simplicity of construction, the "ring" type blower, made of ordinary  $1\frac{1}{4}$ -in. pipe, is recommended. Fig. 11 illustrates the details of the design and the recommended application of the blower.

#### DESIGN AND APPLICATION OF DRAFT SHEET

The draft sheet should be securely bolted to an angle or plate attached to the front end of the table plate and should fit neatly against the sides of the smokebox. While it is recommended that this sheet be applied at an angle of 30 deg. from the vertical, better results are

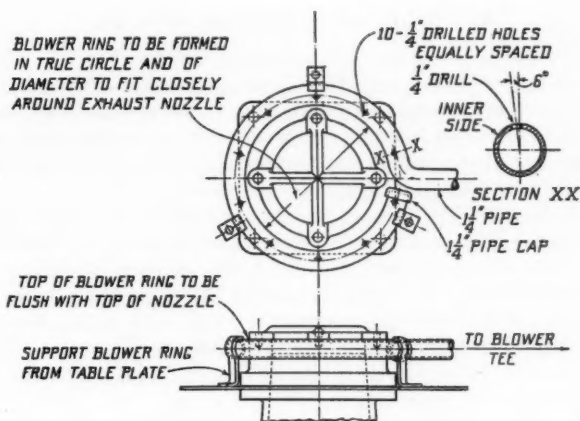


Fig. 11—Blower design and application

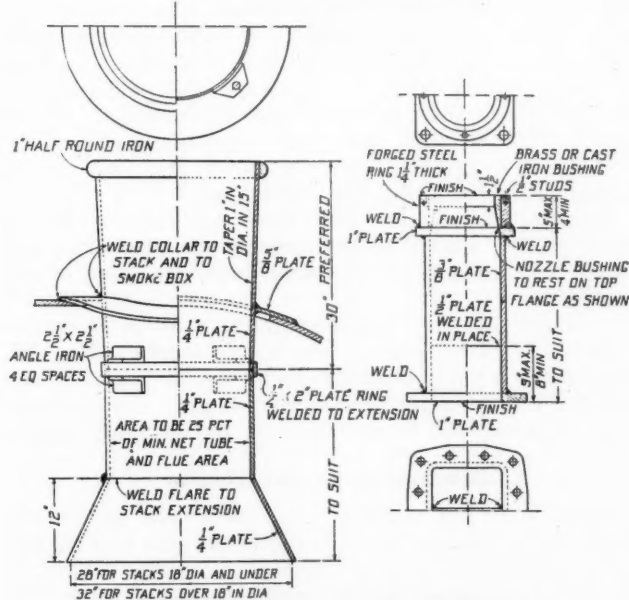


Fig. 12—Plate smokestack and exhaust stand for experimental purposes

secured in some cases when it is set at a greater or lesser angle than 30 deg. The bottom edge of the draft sheet should be perfectly straight and perpendicular to the vertical center line of the boiler. A typical application is illustrated on Fig. 1.

#### DEFLECTING PLATE IN BOTTOM OF SMOKEBOX

A deflecting plate applied at an angle of 45 deg. in the bottom of the smokebox, as illustrated in Fig. 1, is recommended because of its protective value to the smokebox front and because it serves to prevent cinder accumulation at this point. Application of an angle iron across the top edge of this plate as shown has successfully reduced cinder cutting of the smokebox door, door flange and bolts.

#### CONSTRUCTION OF STACK, EXHAUST STAND AND NOZZLE FOR TEST PURPOSES

In order to provide the details necessary to redraft a locomotive for test purposes without the necessity of having patterns constructed and castings purchased, a smokestack and exhaust stand constructed of steel plate may be utilized. Satisfactory results have been obtained in this manner. A typical plate stack and exhaust stand are illustrated in Fig. 12. It will be observed that a removable bushing, held in place by the cross spreader, is used for the exhaust nozzle. This makes it possible to determine the final nozzle size to be used at a minimum of cost for labor and material.

### Assembly of Smokebox Details

**Typical Recommended Arrangement.**—Fig. 1 illustrates a smokebox and Fig. 2 an arch brick arrangement prepared in accordance with the recommendations outlined. For convenient reference the recommended gas areas are also shown, together with other pertinent data mentioned elsewhere in this discussion.

**Points to Be Observed in Assembly of Smokebox Details.**—Too much care cannot be taken in assembling the various smokebox details if the utmost efficiency is to be realized. It is essential that there be perfect alignment of the stack and exhaust nozzle. All plates should be applied exactly in accordance with the drawings. The diaphragm plate, table plate and draft sheet should be tight and free from holes.

**Test for Steam Leaks.**—After applying the exhaust stand a hydrostatic test should be applied. The joints between exhaust stand and cylinder, and between exhaust nozzle and stand should be made perfectly tight during this test. Superheater units should be observed for leaks and tightened if necessary. All pipe joints in the smokebox must be made absolutely tight. Steam leaks in the smokebox can offset the most capable efforts to make a locomotive steam properly and lead to incorrect analyses of the fire conditions.

**Test for Air Leaks.**—Air leaks are responsible for much of the difficulty encountered in obtaining and maintaining good steaming qualities and economical fuel performance.

A simple test for disclosing air leaks in the front end is known as the "smoke" test and is conducted as follows: Place a cover over the entire top of the stack and then throw a quantity of coal on the fire. All air leaks of consequence will be indicated by the escaping smoke.

### Discussion of the Drafts

While it is not necessary to know and record the actual drafts obtained in the combustion area and smokebox in order satisfactorily to draft or redraft a locomotive, this information forms a valuable record, especially where an extensive program of redrafting is undertaken.

Due to difficulty of securing accurate readings of firebox and ashpan drafts on the road, these drafts are given no further consideration in this discussion. If it is desired to obtain a record of these drafts it is recommended that standing tests be made.

Smokebox drafts can be obtained readily in road service and furnish all the data necessary for comparing the effects on the drafts brought about by redrafting. Smokebox drafts of most significance are those taken at the following locations: Above and below the table plate at a point just back of the junction between the smokebox netting and the table plate, and back of the diaphragm at a point approximately on the horizontal center line of the smokebox. Draft-gage pipes applied at the above positions should extend in to the vertical center line of the smokebox with the inner end of each pipe capped and provided with six staggered  $\frac{1}{8}$ -in. drilled holes within a space of 4 in. from the capped end. The draft-gage pipes may be extended to a draft-gage panel in the cab thus providing safe, convenient reading of the drafts. One-quarter inch pipe is satisfactory for this purpose.

### PLOTTING OF DRAFT CURVES

Draft readings should be plotted as illustrated in Fig. 13, plotting draft in inches of water against back pressure in pounds. It has been found helpful when plotting comparative draft curves to illustrate the effect of various smokebox changes to plot the draft at only one position in the smokebox on one sheet. A composite draft sheet

such as shown in Fig. 13, illustrating the drafts at all three positions in the smokebox, should be prepared for record after changes to develop satisfactory steaming qualities and fire conditions have been completed. Draft curves for the original smokebox arrangement should be plotted in order to determine and compare the exact effect of the modified smokebox arrangement on the drafts.

### ANALYSIS OF THE DRAFT CURVES

It will be noted that the draft curves illustrated in Fig. 13 are straight lines with practically the same "falling off" in the drafts from the draft above the table

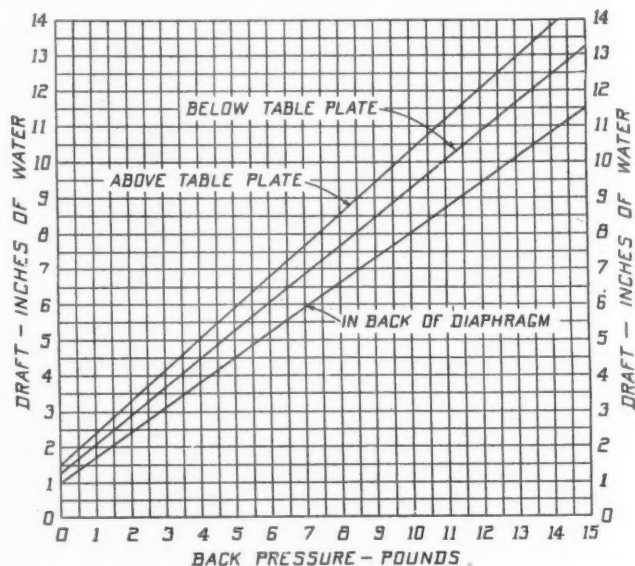


Fig. 13—A typical draft curve

plate to the draft in back of the diaphragm. While the latter condition is ideal it cannot always be obtained due to limitations of design and impossibility of obtaining the preferred proportional gas areas. It should be possible, however, to obtain draft curves represented by straight lines from any locomotive which is properly drafted. Draft curves which fall off in the upper back pressure ranges indicate improper seal of the exhaust blast in the stack. This may account for smoke or other undesirable fire conditions when working the locomotive at its maximum output.

A brief explanation of the draft curves plotted in Fig. 13 is offered at this point. It will be observed on these curves that some draft is indicated at zero pounds of back pressure. This condition will be found to exist in all cases where locomotives are redrafted in accordance with these principles. Due to increase in nozzle bore, back pressure will not be indicated on the gage until the steam chest pressure is from 25 to 50 lb. or higher, depending on nozzle bore. This is probably due to the lack of sensitiveness of the ordinary back-pressure gage. Draft is indicated on the draft gages, however, whenever steam is exhausted from the cylinders, regardless of the amount of steam chest pressure. The drafts illustrated in Fig. 13 at zero pounds back pressure were taken at the point back pressure was about to register on the gage.

### NECESSARY AMOUNT OF DRAFT

While no attempt should be made to state definitely how much draft is necessary to produce satisfactory steaming qualities, with good fire and stack conditions, it has been observed on a large number of locomotives, redrafted in accordance with these principles, that the

best performance has been obtained when the draft in back of the diaphragm in inches of water is approximately eight-tenths of the back pressure in pounds in the normal working range of the locomotive, considered at eight to ten pounds back pressure. This figure is not empirical and is offered for its possible value as a guide.

In summary it is considered advisable to state that each class of locomotives should have only sufficient draft to burn the fire satisfactorily under all operating conditions with free steaming qualities and without smoke. Excessive drafts are to be avoided as they are largely responsible for excessive stack loss and cinder cutting of staybolts, flue sheets and various smokebox details.

### **Locomotive and Fuel Performance Tests to Determine Advantages Due to Redrafting**

#### **STANDING TESTS**

Extensive use of the standing test was resorted to during early experiments in redrafting and assembling the data upon which this practice is based. The standing tests made it possible to make quickly the changes needed to produce satisfactory steaming qualities and provided information of inestimable value in arriving at the proportions recommended.

These proportions and principles of front end design have proved so reliable that a great number of locomotives, redrafted in accordance with them, have been placed in revenue service without preliminary trial. Only minor changes have been required to produce altogether satisfactory steaming qualities and stack conditions. These changes have been made without loss of time to the locomotive in any instance. It is also worthy of note that in no case has a steam failure occurred while redrafting a locomotive. In view of this, standing tests for the purpose of redrafting are not considered necessary and are not recommended.

#### **DYNAMOMETER CAR TESTS**

Where a dynamometer car is available, accurate information on the improvement made in a locomotive by redrafting may be obtained by making a series of comparative tests before and after redrafting. In making such tests a division should be chosen which will provide the most consistent operation from the standpoint of tonnage and speed, and with a minimum of drifting distance. In many cases it is preferable to make the tests over only that portion of a division providing the desired conditions, thus eliminating many variables which affect the locomotive performance. It is always preferable to make the tests with the standard or original smokebox arrangement first, making sufficient tests to obtain accurate average results.

Tests with the redrafted engine to secure comparative data should not be started until it is reasonably certain that steaming qualities and stack conditions are the best that can be obtained.

On all such tests made with the dynamometer car coal should be weighed and water measured. The locomotive should be equipped with a back-pressure gage, steam-chest-pressure gage, steam pyrometer and draft gages. The reverse gear should be calibrated. Gage readings may be taken at mileposts or at specified intervals of time. The usual dynamometer data should also be recorded. All this information is essential to determine the actual benefits of redrafting and affords data for permanent record and study.

In making comparative fuel performance tests it is essential that the locomotive be worked at the same capacity on all the tests. Maintaining an equal average drawbar horsepower on tests with the locomotive before

and after redrafting assures results which can safely be compared, providing this equal drawbar horsepower is obtained with fairly equal average speeds in each case. The coal per drawbar horsepower hour should be used to measure the locomotive fuel performance.

Dynamometer tests may also be conducted to determine the comparative ability of the original and redrafted locomotive to handle trains. In such tests the increased tonnage hauled by the redrafted locomotive or the reduction in running time over the division with equal tonnage will afford comparative data. On tests of this nature in which the average drawbar horsepower of the redrafted locomotive will be higher than that of the locomotive before redrafting, it may also happen that the coal per drawbar horsepower hour of the redrafted locomotive will equal or even exceed that for the locomotive before redrafting. This will be governed largely by the actual improvement in fire conditions and the amount of reduction in back pressure brought about by redrafting and the amount of increase in speed or tonnage, or a combination of both, of the redrafted over the original locomotive.

#### **ROAD TESTS WITHOUT DYNAMOMETER CAR (OBSERVATION TESTS)**

Road tests to determine comparative fuel performance of a redrafted locomotive, when made without a dynamometer car and where coal per 1,000 gross ton miles is used as a basis for comparison, are of no particular value, and may often be misleading, even though the coal may be weighed on such tests. While tonnage and average speed may be kept comparable there are other uncontrollable factors entering in, which may affect coal consumption and the locomotive performance generally.

Increase in tonnage or speed for the redrafted locomotive may be determined without the use of a dynamometer car. Tests or trial runs for this purpose should certainly be made in order that the advantages, brought about by redrafting, may be utilized. Whenever tests are conducted without a dynamometer car it is recommended that cab gage readings, including the draft readings and cutoff, be taken as on dynamometer tests. The data secured will prove of considerable value.

Although in some cases immediate improvements in the fuel and general performance of a locomotive may be obtained by making partial changes in line with these recommendations, the greatest success from an application of the foregoing principles of drafting can be realized only when the procedure indicated is carried out in its entirety as outlined.

The subcommittee report was signed by D. S. Ellis (chairman), mechanical assistant to vice-president, C. & O., and A. H. Fetters, general mechanical engineer, U. P.

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A HUNDRED YEARS AGO—The following is an excerpt from a letter written on July 22, 1835:

This morning at 9 o'clock I took passage in a railroad car from Boston, Mass., to Providence, R. I. Five or six other cars were attached to the locomotive, and uglier boxes I do not wish to travel in. They were made to stow away some 30 human beings who sit cheek by jowl as best they can. By and by just 12—only 12—bouncing factory girls were introduced who were going to a party of pleasure to Newport. "Make room for the ladies!" bawled out the superintendent. "Come, gentlemen, jump up on the top, plenty of room up there." The rich and the poor, the educated and the ignorant, the polite and the vulgar, all herd together in this modern improvement in traveling, master and servant, sit in each other's laps, as it were, in these cars, and all this for the sake of doing very uncomfortably in two days what would be done delightfully in 8 or 10.

# COUNTERBALANCING

SEVERAL papers and articles on the subject of counterbalancing have appeared in the last few years. Practically all have agreed that the crossbalancing of the main wheels results in a considerable reduction of the dynamic augment and a much better riding locomotive.

The following is an investigation to compare the dynamic augment of the main driving wheels of a locomotive when the revolving weights are crossbalanced with the dynamic augment of the same wheels when the revolving weights are simple balanced. In this discussion all weights mentioned are in pounds.

The locomotive chosen for consideration has the following characteristics:

Type .....	4-6-2
Cylinders, diameter and stroke.....	22 in. by 28 in.
Driving wheels, diameter.....	73 in.
Weight on driving wheels.....	53,000 lb.
Total weight of locomotive in working order.....	240,000 lb.
Steam pressure .....	200 lb. per sq. in.

In this discussion the following designating terms are employed for the weights considered:

- W = Weight of the locomotive.
- W<sub>1</sub> = Total weight of reciprocating parts.
- X = Total weight of main rod.
- X<sub>1</sub> = Weight of main rod considered as revolving.
- X<sub>2</sub> = Weight of main rod considered as reciprocating.
- X<sub>3</sub> = Weight of back end of main rod.
- Y<sub>1</sub> = Weight of side rods on main pin (four coupled).
- Y<sub>2</sub> = Weight of side rods on intermediate pin (four coupled).
- P, Q, N, M, = Scale weights of side rods at points indicated in Fig. 2.
- Y<sub>3</sub> = Weight of side rods on main pin (three coupled).
- Z<sub>1</sub> = Weight of large end of eccentric crank with included part of crank pin.
- Z<sub>2</sub> = Weight of small end of eccentric crank plus portion of eccentric rod considered as revolving.
- Z<sub>3</sub> = Equivalent weight of Z<sub>2</sub> at point O (Fig. 1).
- Z<sub>4</sub> = Equivalent weight at large end of eccentric crank when Z<sub>3</sub> is considered as Z<sub>2</sub>.
- Z<sub>5</sub> = Equivalent weight at crank pin radius of Z<sub>2</sub>.

**Eccentric Crank**—For proper counterbalancing, the weight of the small end of the eccentric crank must be considered in its proper relation to the other revolving parts. A method for making this consideration (see Fig. 1) follows:

$$Z_3 = \frac{Z_2 A}{A + B} \quad (1)$$

$$Z_4 = \frac{Z_2 AD}{(A + B) C} \quad (2)$$

$$Z_5 = Z_1 + \frac{Z_2 B}{A + B} \quad (3)$$

**Main Rod**—That portion of the weight of the main rod to be balanced as revolving weight is found by the formula:

$$X_1 = \frac{X r^2}{l^2} \quad (4)$$

where  $r$  = radius of gyration of the main rod about the wrist pin in inches.  
 $l$  = length of main rod from center to center in inches.

The remaining weight to be considered as reciprocating weight is:

$$X_2 = X - X_1 \quad (5)$$

The radius of gyration of the main rod can be found either experimentally or by computation. If the former method is chosen the main rod should be swung as a pendulum about its wrist pin center, and its time of oscillation noted. Then the radius of gyration can be found by the formula:

$$r = \sqrt{3.26 t^2 a} \quad (6)$$

where  $r$  = radius of gyration in inches  
 $t$  = time of one swing, in second.  
 $a$  = distance from wrist pin center to center of gravity of main rod.

A fairly close approximation for the revolving weight

By Kenneth F. McCall

## An investigation to determine comparative dynamic augment with simple balancing and crossbalancing

of the main rod can be made by the following formula:

$$X_1 = 0.875 X_2 \quad (7)$$

That portion of the eccentric rod weight to be considered as revolving with the small end of the eccentric crank may be determined by the same methods that gave formulas 4 and 6.

**Reciprocating Weights**—The percentage of reciprocating weights to be balanced may be found by the formula:

$$\text{Per cent to be balanced} = \frac{16s W_1 - W}{16s W_1} \quad (8)$$

where  $s$  = piston stroke in inches,  
 $W_1$  = total weight of the reciprocating parts, including  $X_2$  in Formula 5.

**Side Rods**—The weight on each crank pin due to the side rods is determined by treating each side rod separately as shown in Fig. 2 which shows the side rods for a four-coupled locomotive. The four-coupled arrangement, however, is used for illustrative purposes only. In Fig 2, the weight on the main and intermediate pins,

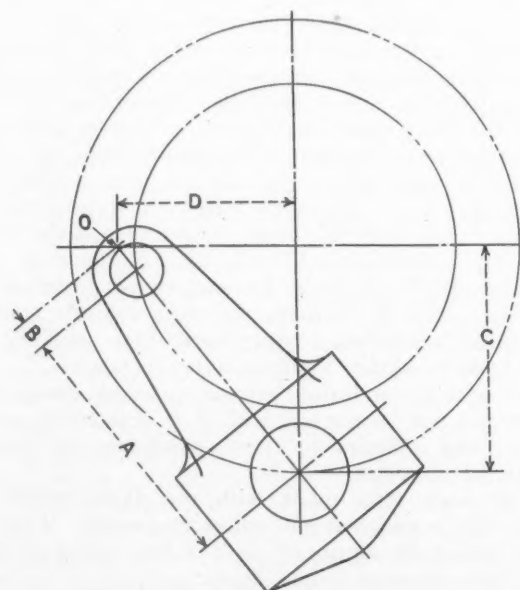


Fig. 1

respectively, due to the side rods may be found by the formulas:

$$Y_1 = Q + \frac{P(F + G)}{F} - \frac{ME}{F} \quad (9)$$

$$Y_2 = N + \frac{M(F + E)}{F} - \frac{PG}{F} \quad (10)$$

where weights and distances are as shown in Fig. 2.

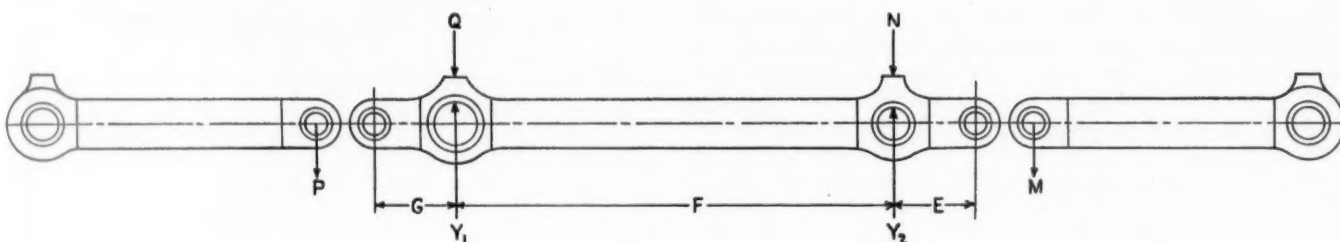


Fig. 2

For the locomotive under discussion, a 4-6-2 type, the formula for the weight of the side rods on the main pin would be:

$$Y_a = Q + \frac{P(F+G)}{F} \dots\dots\dots (11)$$

**Dynamic Augment**—The dynamic augment should be considered as acting in the vertical plane passing through the point of contact between the wheel and rail, herein called the "plane of the rail," and not in the plane of the counterbalance.

The vertical component of the main rod due to the steam pressure should be added algebraically to the dynamic augment after due allowance has been made for transferring this component into the plane of the rail, and the force necessary to accelerate and decelerate the reciprocating parts has been subtracted.

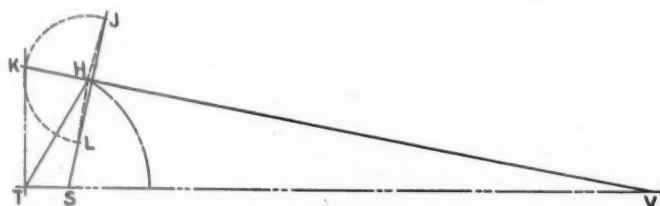


Fig. 3

A method for finding this acceleration is shown in Fig 3, where

TK=the vertical center line of the wheel.  
TV=the center line through the wheel and cylinder neglecting the difference in height between the two.

TH =  $\omega^2 R$   
 $\omega$ =the angular velocity of the crank pin in radians per second.  
R=the crank-pin radius in feet, to be laid off at any desired crank angle.

$$HV = \frac{(L)}{(R)} \omega^2 R$$

$\frac{L}{R}$ =the ratio of the main rod length to the crank radius.

HK=HV extended to intersect TK at K.

LKJ=an arc swung about H as a center.

LHJ=an arc swung about V as a center.

JLS=a straight line drawn through the intersections of arcs LKJ and LHJ and extended to intersect TV at S.

Then TS=the acceleration in feet per second of the reciprocating parts for that particular crank angle.

This was done for every 15 deg. of the crank angle through one complete revolution of the wheel, the speed of the locomotive being taken as "diameter speed," or 73 m.p.h.

The total piston pressures were computed for every 15 deg. from indicator cards resolved into stroke cards. Allowance was made for the area occupied by the piston rod on the back side of the piston, and for back pressures on opposite sides of the piston.

The forces necessary to cause the acceleration found by the method described for each crank angle were subtracted algebraically from the corresponding piston pressures. The remaining piston pressures were resolved into vertical components acting at the crank pin, their values depending on the angle of the main rod. This component was added algebraically to the dynamic aug-

ment after it had been transferred into the plane of the rail.

**Graphs**—The dotted line on Fig. 4 represents the vertical forces working in the plane of the rail on the right wheel caused by the left main rod. The broken line represents the vertical forces working in the plane of the rail on the right wheel caused by the right main rod. The full line is the sum of these two vertical forces.

The procedure for computing the 90-deg. weight to go in each wheel when crossbalancing, and finding the angle to offset the counterbalance, has been written up so many times that it is not deemed necessary to give it again.

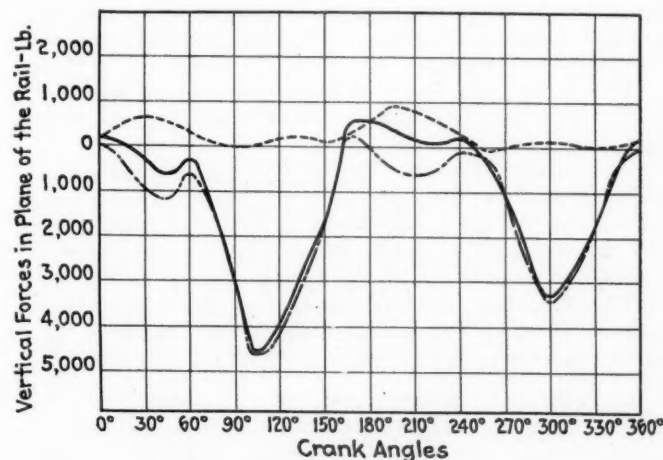


Fig. 4

The following table gives the necessary data to work this out:

Weight of side rods, including the encircled part of the crank pin.....	523.3 lb., by Eq. 11
Weight of main rod, including the encircled part of the crank pin.....	471.8 lb., by Eq. 7
Weight of large end of eccentric crank, including the encircled part of the crank pin.....	95.1 lb., by Eq. 3
Weight of small end of eccentric crank, including that part of the eccentric rod considered as rotating....	61.8 lb., by Eq. 2
Equivalent weight of crank pin hub.....	287.0 lb
Distance between:	
Planes of the rail.....	59.00 in.
Crank-pin hub centers.....	64.00 in.
Counterbalance centers .....	64.00 in.
Side rod centers.....	75.26 in.
Main rod centers.....	87.00 in.
Large end of eccentric crank centers.....	96.20 in.
Small end of eccentric crank and part of eccentric rod considered as rotating, centers.....	101.00 in.

Considering the revolving parts to be completely crossbalanced there will be no dynamic augment other than that caused by the weight added in the counterbalance for the reciprocating weights. To this must be added the vertical component of the main rod.

The weight added for the reciprocating parts was placed opposite the crank pin and was determined by Equation 8. The percentage to be balanced was 59 per cent and was split up equally among all six driving wheels.

The weight added for the reciprocating parts was transferred into the plane of the rail and then the dy-

dynamic augment at diameter speed computed for a complete revolution at 15-deg. intervals. To this was added algebraically the corresponding vertical components of the main rods. The sums of the dynamic augments and the vertical components for each 15-deg. interval were plotted, resulting in Curve B, Fig. 5, for the right-hand side, and Curve D, Fig. 6, for the left hand side. In both graphs the crank angles given start with the right-hand crank pin on forward dead center, and consider the wheel to be rolled forward. That is, the left crank is considered to start at 270 deg.

When the wheels are simple balanced the counterbalance weight at crank-pin radius is the sum of the rotating weights and one-sixth of the percentage of the reciprocating weights to be balanced. The procedure is the same as before except that the 90-deg. weight to go in the opposite wheel is not put in. On this locomotive the result of the simple balancing is shown in the following table:

	Right Wheel	Left Wheel
180 deg. Overbalance .....	122.3 lb.	78.4 lb.
90 deg. Underbalance .....	240.7 lb.	73.2 lb.
Resultant weight .....	270.0 lb.	107.2 lb.
Resultant angle with the horizontal in the second-quarter .....	63 deg. 4 min.	47 deg. 0 min.

The weights and resultants in the above table work in the plane of the rail. The vertical components of the resultants were computed for every 15 deg. of the crank angle as in the cross balanced method and their centrifugal forces computed. To this was added the main rod effect as before.

These intervals were plotted, resulting in Curve A, Fig. 5, for the right side, and Curve C, Fig. 6, for the left side.

An inspection of the curves shows that there is little to be gained by crossbalancing the main wheels of this locomotive as far as the right side is concerned, while on the left side crossbalancing is at a distinct disadvantage compared to simple balancing.

The following is a table comparing the maximum resultant vertical components (dynamic augment plus main-rod effect) for the two systems of balancing:

	Maximum Vert. Comps.		Angle of Right Crank	
	Right side	Left side	Right side	Left side
Crossbalanced .....	13,900 lb.	13,900 lb.	285 deg.	75 deg.
Simple balanced .....	14,250 lb.	4,960 lb.	315 deg.	15 deg.

It is apparent from previous papers on counterbalancing that the sum of the static load and the dynamic augment has been considered as the stressing load on the rail. In a discussion of Lawford H. Fry's "Locomotive Counterbalancing," printed in the June, 1934, "Transactions of the A.S.M.E.," A Giesl-Gieslingen expresses the opinion that a dynamic augment of 15 to 20 per cent of the static wheel load will stress the rail only slightly higher.

The theory that the magnitude of the dynamic augment is not a direct measure of the increase or decrease in rail stress seems reasonable when it is considered that the rails and ties act as a vibrating beam. The true increase or decrease in rail stress would be in increase or decrease of pressure between wheel and rail caused by the resultant vertical force in the wheel to or from the rail. This would represent the true dynamic augment. However, for the sake of convention, the author of this paper has given the term "dynamic augment" its usual interpretation, with the exception noted in the paragraph immediately following Equation 11.

The dynamic action of reciprocating and out-of-plane revolving masses encountered in locomotive machinery produces several undesirable effects which must be absorbed by the locomotive, the train, and the right of way. These effects are: Vertical oscillation, longitudinal oscillation, lateral oscillation, rolling, nosing, and galloping.

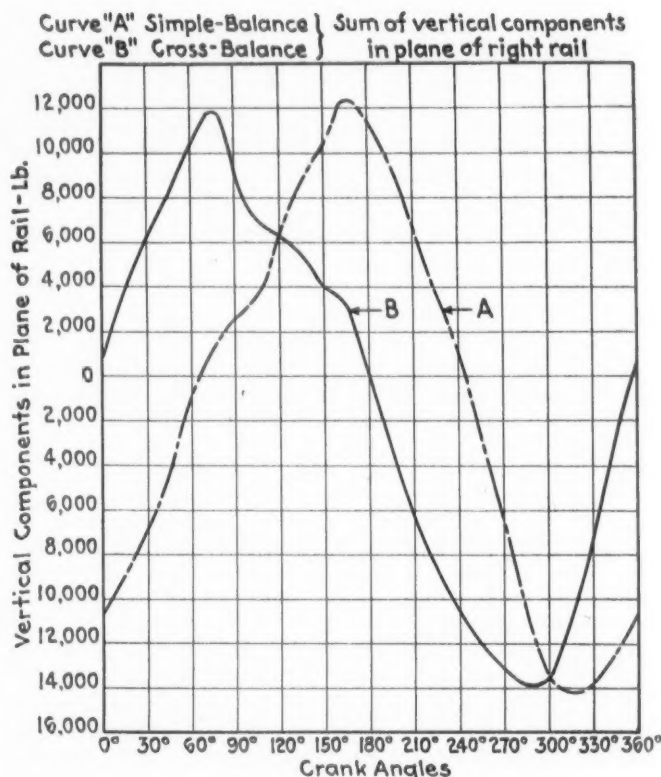


Fig. 5

Vertical oscillation and rolling are partially due to the dynamic augment. It is imperative to distinguish clearly the difference between dynamic augment, longitudinal oscillation, and nosing, because any attempt to improve one condition would be done at the expense of one or both of the others.

The dynamic augment is not the whole cause of variation in rail load, because of the vertical component produced in the main rod from the thrust and pull of the piston pressures and the inertia of the reciprocating

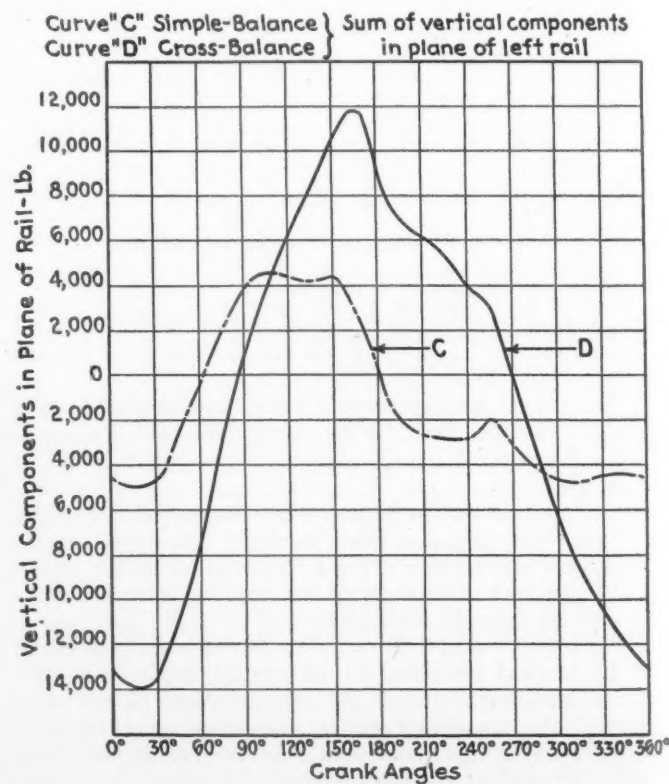


Fig. 6

parts. The angularity of the main rod causes the acceleration of the reciprocating parts to vary throughout the stroke. The piston pressures will also vary due to cutoff, expansion and other thermodynamic changes that normally take place in the cylinders. These two factors make it impossible to balance and thus reduce that portion of the variation in rail load, although they should be taken into account when the total resultant vertical force of the rotating parts is being computed.

Undoubtedly it would be desirable to balance for the valve gear, but owing to the complicated motions and the variations in cutoff it would be impossible. However, no counterbalancing could be called accurate unless a portion of the eccentric rod was considered.

Crossbalancing of the main wheels would reduce the dynamic augment in them to zero if it were not for the vertical component in the main rod and the weight added to the balance for the reciprocating parts. Too great a reduction in the percentage of reciprocating parts balanced will increase the longitudinal oscillation. If this reduction is carried too far these oscillations will be felt

quite plainly in the forward part of the train, causing discomfort to the passengers. A decrease in percentage of reciprocating parts balanced means a decrease in dynamic augment and an increase in the longitudinal oscillations.

It has been suggested that for a complete balance the weight in the counterbalance for the reciprocating weights should be crossbalanced also. This would reduce the nosing, increase the dynamic augment, and make no difference in the longitudinal effect.

It has also been suggested that no reciprocating weights be balanced in the main wheels, adding extra weight in the coupled wheels to make up the deficiency, and completely crossbalancing the main wheels. While it is true this would reduce the dynamic augment in the main wheels to that caused by the vertical component in the main rod, it would increase the dynamic augment in the coupled wheels, tending to put a kink in the rail between the two coupled wheels adjacent to the main wheel. How much harm this would do the rail is a matter for further investigation.

### Federal Co-ordinator's Report on

# Modernization of Shops

ON JUNE 12 the Federal Co-ordinator of Transportation issued a report on the consolidation and modernization of repair shop facilities which was prepared by the Section of Property and Equipment. This report deals with the studies of the original co-ordinating committees to determine the economies in maintenance of equipment which might result from consolidation or joint use of existing major shop facilities and the study undertaken by the Section of Purchases which ascertains the economies which might reasonably be expected to result from carrying out a complete program of modernization of repair shop facilities.

### Conditions Supporting Shop Situations

The report indicates that there are in existence (although not necessarily in active operation), 403 locomotive repair shops; 568 freight and passenger car shops and 3,271 enginehouses. The report points out that the present situation with respect to the large number of existing repair shops, is, in general, the result of conditions brought about by the consolidation, in some cases many years ago, of numerous small railroads, each of which had provided repair facilities which were considered suitable for the then existing individual requirements and for the accommodations of small light capacity locomotives and cars.

Excessive maintenance costs have naturally resulted from the use of shop facilities unsuited, even if new, for repairing equipment of sizes, weights and designs not contemplated in the original design of the shops and their equipment. None of the great railway systems of this or any other country were originally planned or built as such, hence the great variation in policies methods and operating practices.

It is significant to note that several of our most successful railroads, measured by low operating costs and regular dividend payments to stockholders, are those roads which have consolidated their repair operations into the least possible number of shops, and have provided

modern equipment and facilities for maintenance. This policy, combined with highly efficient management, has made it possible for them to use motive power and rolling stock much more intensively than the average railroad, hence requiring a minimum investment in the equipment required to perform a given volume of satisfactory transportation service. Intensive use of equipment naturally requires a high standard of maintenance, which is fully justified by the overall performance of those railroads, and definitely points the way to lower operating costs.

The almost revolutionary changes in operating conditions since the advent of steel freight cars, and of high powered locomotives making possible the hauling of trains consisting of 100 to 150 cars and more, over long distances at high speeds, have eliminated the necessity for many intermediate yardings en route, with the result that many shops and yards are no longer geographically located in the right place to meet existing conditions. During the era of railroad expansion from 1865 to about 1900, many small new railroads were built. Quite a number of the shops built during that period are still in use, having been enlarged, and additional machinery equipment installed. It would today be a hopeless task to modernize and relocate these facilities in such a way as would enable their efficient use for repairing modern equipment to meet the requirements of present day operating conditions.

### The Equipment-Maintenance Situation

Locomotive heavy repairs are by far the most complicated work connected with equipment maintenance. The layout and arrangement of repair facilities considered most economical for one type of locomotive and for certain details of design will not be the most economical for locomotives of radically different type or design. Each railroad has established a certain degree of standardization in the design and details of locomotives, to suit its individual needs, and until some general standardization is accomplished, this situation will still further complicate the problem of maintenance when

# **Relation of the Approximate Value of Shops and Enginehouses, and Shop Machinery to Expenditures for Improvement June 30, 1914, to December 31, 1931**

Account	(1) Reproduction value as of Dec. 31, 1931	(2) Net expendi- tures for additions and betterments 17.5 years	(3) Average expenditure per year	(4) Cycle of time required for complete replacement (years)	(5) Indicated average (years)
(a) Shops and enginehouses (Acct. 20).....	\$678,706,319	\$282,670,876	\$16,152,620	42.018	21.009
(b) Shop machinery (Acct. 44).....	320,493,901	128,610,000	7,349,100	43.600	21.800
Total .....	\$999,200,220	\$411,280,885	\$23,501,720	42.516	21.258

locomotives owned by one road are sent to the shops of another for major repairs. Experience with this phase of maintenance during Federal control, (1918-1920) when some 3,000 locomotives were sent to shops other than those of the owning line, demonstrated beyond question that delays and duplication of investment in parts, due to differences in design and standards of maintenance, must be expected so long as so many different standards exist. There must be real national standardization in the matter of locomotive design, shop practices, limits of wear, and policy of renewals, before full advantage can be taken of joint use of heavy repair shops especially when those shops must be used to repair locomotives of widely different design intended to serve different transportation requirements.

Freight car repairs represent one of the largest single items in the maintenance of equipment accounts. The two million odd freight cars are freely interchanged and used by all railroads under A.A.R. Car Service Rules. Because of the many different types, sizes, and styles, they present a most difficult problem so long as they continue to be owned by 144 individual Class I Railways and maintained to different standards of physical condition. They must, however, be maintained in a safe and suitable condition for service on all roads, regardless of location with respect to repair shops of the owning roads.

Freight car maintenance averaged per year \$326,599.-432 for the fifteen year period 1920-34 inclusive, \$357,-550.085 for the thirteen year period 1920-32 inclusive, \$407,710,936 for the ten year period 1920-29 inclusive, and \$164,376,425 for the five year period 1930-34 inclusive. The difference between the two latter figures, when adjusted for the different number of cars and difference in intensity of use during the two periods, represents the degree of undermaintenance occurring between the two periods. Freight cars of modern design will run about five years from date built before requiring heavy repairs which include wheel renewals, painting etc., and will require similar treatment about every three years thereafter. About 10 to 12 years from the date built, the average freight car will require extensive renewal of body parts, this type of repairs being usually termed "rebuilding."

The advantages of a single owning agency, from the standpoint of transportation, have been presented in reports of the Co-ordinator's Section of Car Pooling. The advantages of single ownership from the standpoint of maintaining equipment are of about equal financial importance, since cars could be more fully standardized as to all parts than when individual standards are maintained by 144 Class I railroads. By locating major repair shops at strategic points adjacent to important area gateways, all major classified repairs could be made by the owning agency with a minimum of empty car movement between points of use and points of repairs and between the latter and loading areas.

The total number of passenger-train cars owned (excluding Pullman cars) was 43,845 as of December 3, 1934. Most of the work involved in repair operations

on this equipment consists of manual labor, such as cleaning, painting, upholstering, and refinishing hardware and trim, and can be performed with almost equal economy in any reasonably well-equipped plant. The only work requiring overhead crane service is the lifting of cars sufficiently to remove and replace trucks and making actual repairs to the trucks and other heavy parts. Heavy repair work could be advantageously concentrated and performed in modern fireproof facilities.

## **The Cost of Obsolete Shop Machinery**

Detailed information obtained from three reputable manufacturers—(a) a machine tool builder, (b) an automobile manufacturer and (c) an electrical equipment manufacturer—shows that the average age of machine tools in these three groups is between 8 and 9 years, and of a comparatively few individual tools, more than 12 years. The combined annual machine-tool repair cost is equal to 1.2 per cent of the original cost, as compared with an average of 7.4 per cent annual repair cost for all railroad shop machinery having an average age of 21.8 years. Under a general policy of renewal of machine tools on all railroads so planned that the average age would not exceed 7½ to 8 years, with an ultimate life of 15 to 16 years, instead of 21.8 and 43.6 years respectively, it is reasonable to assume that the annual repair cost would not exceed 1.2 per cent of total investment, or \$3,846,000, a reduction of \$19,854,000 below the annual average of \$23,700,000 expended during the 12-year period 1920 to 1931 inclusive.

It is evident from the above facts that if the average age of all railroad shop machinery were reduced from 21.5 to 7.5, or 14 years on the average, the saving in repair cost alone at \$19,854,000 per year would amount to \$277,956,000, or 87 per cent of an amount sufficient to replace all existing shop machinery, without considering any other advantages of the ownership and use of modern high production machine tools, including lower production costs and more accurate products.

An illustration of the inadequacy of railroad repair shops as a whole to perform repairs economically on large modern locomotives is found in the fact that the average cycle of replacement of all shops and engine houses is 42.018 years, corresponding to an average age of 21.009 years. During this length of time, the average tractive power of all steam locomotives has increased from approximately 31,250 pounds to an average of 46,400 pounds in 1932, or 48 per cent, resulting in corresponding increases in weight and size. In addition, a great many locomotives have been equipped with large capacity tenders, resulting in much difficulty and additional expense in making needed repairs, with facilities originally built to accommodate much lighter and shorter power.

## **Estimated Savings from Complete Modernization and Joint Use of Repair Facilities**

The estimated savings that can reasonably be expected to result from a complete modernization program of repair shop buildings, facilities and machinery based

upon the actual experience of those who were in direct charge of such a program and after making due allowance for average conditions differing from the specific case studied are conservatively calculated and shown in one of the tables.

The total estimated savings will be \$365,902,000 per annum. The expenditure of new money necessary to accomplish this result will be approximately \$1,141,350,000 indicating a return of 32.05 per cent per annum.

Based upon the average operating revenues and expenses, for the 10-year period 1923 to 1932 inclusive, a saving of \$318,319,000 in the operating expenses would have resulted in a ratio of operating expenses to operating revenue of 68.93 per cent instead of the actual ratio of 74.63 per cent. The entire amount of the total annual savings in operating expenses and fixed charges (interest, taxes and insurance) amounting to \$365,902,000 will be available after 3.12 years of operation, (the period required to save the entire cost of improvements) for the payment of dividends since the amount of retirements of equipment and facilities made possible by the modernization program will exceed by a small margin the cost of the new facilities.

Particular attention is directed to the fact that in preparing the estimate of possible savings, wherever there was more than one basis on which to compute the savings, the one resulting in the smaller amount was invariably selected. No effort was made to search out the small savings such as for example the space required for the storage of the 255,698 freight cars that are in bad order at all times in excess of a reasonable amount (4 per cent) which requires the use of 1,937 miles of tracks.

The estimated savings are the combined results of management, operation and proper facilities. The amount of saving due to any particular phase cannot be determined separately with the data available.

### General Conclusions

Consideration of the facts presented in this report leads to the following conclusions:

1—Railroad repair facilities, as a whole, include an unduly high proportion of obsolete buildings, machinery, and accessory equipment. The continued use of these obsolete facilities results in high costs of maintaining equipment, not only in respect to actual work performed, but also in respect to the quality of the work. This applies particularly to machine-tool work, in which the ac-

curate dimensioning and close tolerances required for easy fitting and assembling, and minimum running repairs, cannot be secured without modern machine tools, even though older tools have been maintained in a condition as good as new. While it is obvious that railroad repair shops cannot be operated on a mass production basis such as that of automobile plants, the contrasts between the most modern and the average railroad shops, as to layout, equipment, methods, and results obtained, demonstrate clearly that modernization will pay large dividends on any reasonable investment made with proper consideration of all factors, including not only repair costs but average condition and service requirements of locomotives and cars.

2—Consolidation or joint use of existing major repair shops, without installing new machinery, will result in comparatively small savings. Somewhat larger savings could be made if new machinery were installed in the shops selected for joint use, but savings through the use of modern machinery, though important, represent only about 20 per cent of total savings estimated to be possible through complete modernization of shops together with establishment of sound policies in respect to condition of equipment and maintenance schedules. Most existing shops were designed to perform both classified repairs and running repairs, and consolidation of classified repairs would not permit abandonment of any considerable number of existing shops.

3—No general program for replacing shop machinery should be adopted until a sound and balanced plan has been worked out in respect to average condition of locomotives and cars, repair schedules required to maintain that average, and kind and location of repair facilities needed for the purpose. Such a plan will undoubtedly involve abandonment of certain existing facilities and construction of some new facilities, as well as installation of modern machinery. Neither redistribution of work among existing shops, nor installing new machinery in such shops, can accomplish maximum attainable results. Such results can be obtained only through a combination of both, made in accordance with a general plan such as that mentioned above.

4—Except for normal replacement of obsolete locomotives and cars, unsuited to modern transportation requirements and known to require unduly high maintenance, no new equipment should be purchased until the surplus of unserviceable equipment has been eliminated, and policies set up whereby the average proportion of bad-order equipment can be limited to 14 per cent for locomotives and 4 per cent for freight cars.

5—The opportunities for making substantial reductions in total operating expenses through reduced cost of maintaining equipment are too great to be disregarded. Conditions during the past five years have been such as to preclude any expenditure not immediately necessary, and in many instances railroad managements have been obliged to lower their normal standards of maintenance of all property and equipment. Much deferred maintenance will have to be made up in the near future in order to preserve railroad properties in condition to handle even the present volume of traffic to the satisfaction of their patrons. This situation presents a real opportunity for constructive long-range planning in all phases of railroad operation, by individual railroads and co-operatively through the Association of American Railroads. The establishment of proper standards for equipment operation and maintenance, and soundly planned modernization of the facilities needed to maintain such standards, should result in a degree of efficiency and economy comparable to that attained by the railroads as a whole in operating their freight and passenger trains.

Summary of Net Charges to Investment in Road and Equipment, Class I Steam Railway Companies and Their Non-operating Subsidiaries

Year	(1) Total net charges to investment in road and equipment	(2) Shops and engine- houses (primary Acct. 20)	(3) Shop machinery (primary Acct. 44)	(4) Total shops and engine- houses, and shop machinery (Col. 2 + 3)
1931	\$540,727,971	\$9,999,133	\$4,910,212	\$14,909,345
1930	590,204,981	10,082,324	5,283,268	15,365,592
1929	552,239,423	13,222,324	4,568,011	17,790,335
1928	458,998,490	7,949,799	4,033,163	11,982,962
1927	698,068,811	17,259,317	8,103,097	25,362,414
1926	652,418,776	26,207,787	11,303,873	37,511,660
1925	579,974,749	23,157,807	10,178,104	33,335,911
1924	714,251,390	22,057,022	13,018,512	35,075,534
1923	808,207,770	27,011,249	14,671,652	41,682,901
1922	362,089,974	9,318,500	6,392,015	15,710,515
1921	442,043,129	16,626,817	7,905,243	24,532,060
1920	551,459,137	14,003,255	7,466,414	21,469,669
1919	319,805,771	26,815,981	11,384,145	38,200,126
1918	466,528,437	27,644,204	7,775,692	35,419,896
6/30/14 through 12/31/17	\$2,692,898,733	\$31,315,357	\$11,616,608	\$42,931,965
Totals 17.5 years	\$10,429,917,542	\$282,670,876	\$128,610,009	\$411,280,885
Average per year	595,995,000	16,152,620	7,349,100	23,501,720
Per cent of total	100	2.71	1.23	3.94

# EDITORIALS

## Man-Power For the Future

The railroad shops are now running more nearly on a normal basis than they have for several years, although they are repairing only as many locomotives and cars as appear to be clearly necessary on the present basis of commerce and industrial production. The heads of the mechanical departments, carefully and critically studying every move, are attempting to anticipate the needs of the operating departments, but are making their estimates on a fairly conservative basis and are keeping only far enough ahead of the demands to insure a reasonable degree of safety.

On some railroads locomotives long out of service, but with considerable mileage still to be run, may be made available with a small amount of back-shop work to put them into serviceable condition. Incidentally, on not a few railroads, the mileage between shoppings has been so greatly extended because of more careful inspection and better engine-house maintenance that really surprising results are being obtained. This also insures a certain amount of reserve that was not available under former conditions.

But what of the human element? Many of the older skilled workers have dropped out during the depression years and will never return to railroad service. Meanwhile, few new mechanics have been made although some of the railroads have gone ahead with apprentice training on a modest scale. Concern is now being shown in many quarters over the possible shortage of skilled labor as business continues to pick up and greater demands are made for equipment. Some roads have already speeded up their apprentice training activities and the class room and shop instructors are back on the job or are giving more time to it, if they were not entirely displaced during the lean years.

In looking over two groups of apprentices recently in widely separated sections of the country, one could not but be impressed by the fact that they were made up largely of high school graduates. Questions asked by these boys indicated an ambition and keen desire to make the most of their opportunities. They are not quietly riding along with the current, but seem to be using their heads and studying the situation to determine how best to take advantage of it. Among the questions that some of them asked were these:

"I am a boiler shop apprentice. Will the use of the Diesel engine eliminate my trade? How can I protect myself?"

"What effect, if any, will competition from other common carriers have on the railways?"

"Will the railroads continue to be the backbone of the transportation system of this country?"

"Will it be wise for me to take a correspondence school course in addition to my regular apprentice training?"

"How can I train myself for work on Diesel-electric locomotives?"

"Would you advise me to try to get a college training? If so, shall I wait until my apprentice training is completed or shall I break away at the end of my first, or second, or third year of apprenticeship?"

The railway mechanical departments can help themselves by assisting these boys to "find themselves" and secure the best training for the future.

"Yes," said a shop superintendent, "I encourage boys with the right personality and ability to leave the service and go to college if they can finance themselves. I lose them, but in most cases they are favorably disposed toward the railroads and may come back to our railroad or some other railroad when they secure their degrees. Most of the boys, however, will complete their apprenticeship and remain with us. Unless I miss my guess, we will be sorely in need of trained mechanics in the not distant future. Indeed, if we add much more to our present operations, we will begin to feel the pinch for trained mechanics. Incidentally, some of these lads will also be needed within a few years for supervisory positions. Frankly, I have been trying to select some of them for apprentice training with that end in view."

What of the future?

## Herbert N. Gresley Knighthood

Each year on the birthday of the King high honors are conferred on men and women who have rendered outstanding services in the British Empire. On June 23 of this year, King Edward VIII, on his first birthday since his accession to the throne, announced an honors list which included Chief Mechanical Engineer Herbert Nigel Gresley of the London & North Eastern Railway as a Knight Bachelor.

The honor conferred upon Mr. Gresley will meet the approval of railroad mechanical engineers throughout the world who have followed with keen interest his efforts in the improvement of locomotive design for these many years. Americans are familiar with and proud of officers of the Canadian railways who have in the past received birthday honors, including such men as the late Sir Henry Worth Thornton, Sir George Bury and Sir Edward Wentworth Batty. We do not recall, however, any railroad mechanical department officer who has been recognized in this way.

The London Times in commenting on the birthday

honors mentioned Mr. Gresley as "engineer (and speeder-up) of the London & North Eastern Railway." To make his position more clear to American readers, he is the head of the mechanical department of a railroad which, according to the latest reports at hand, had 6,091 steam locomotives, 19,241 coaches, 254,825 freight cars and 44 steamboats. It is pointed out by the Railway Gazette (London) that "he inherited the big-boilered engine, an inheritance he has judiciously developed, all the heavy duty locomotives of this design having been equipped with that essential of reliable and efficient performance." He was also responsible, among many other innovations, for "the corridor tender which, by enabling engineers to be relieved on the way, made possible the 392-mile non-stop run of the Flying Scotsman between London and Edinburgh, and the high-speed streamlined Silver Jubilee Express, which averages 70½ m.p.h. over the 232 miles non-stop between London and Darlington."

Mr. Gresley is also this year's president of the Institution of Mechanical Engineers. He is probably better known to American railroad officers than any mechanical-department officer outside the North American continent.

## **The Locomotive and Public Relations**

The railroads have only awakened in the last few years to the prime importance of the locomotive in helping to make friends and boosters for them—and surely the railroads of this country are sorely in need of friends! Here and there at intervals in the '20s a mechanical-department officer would more or less timidly place a new or remodeled locomotive where the public could view it, but usually such a demonstration was made only at a shop point or at some important terminal, and was not systematically followed up with showings elsewhere.

Ed Hungerford, with his gift for pageantry and showmanship, put on the Fair of the Iron Horse at Halethorpe, Md., in connection with the Centenary of the Baltimore & Ohio in the fall of 1927; this he followed with the Wings of the Century at the Chicago Exposition in 1933-34; and now he is showing the Parade of the Years at the Great Lakes Exposition at Cleveland. No one can predict the extent of the favorable impression for the railroads which these pageants have made upon the minds of the American people. The high-speed streamline trains have likewise caught the imagination of the great multitudes. Indeed, in many instances they have undoubtedly gripped it more forcefully than the airplane and the dirigible. There is something more majestic, more powerful and at the same time more intimate, particularly in the case of the steam locomotive.

It does not require an entire train or a big spectacle to attract attention and make friends for the railroad.

The Pennsylvania Railroad recently streamlined a Pacific type steam passenger locomotive at its Altoona Works. It was designed on the basis of painstaking experiments in the aerodynamic testing laboratory at New York University. The railroad has recently been exhibiting this locomotive at various points in the Western, Central and Eastern regions. Circus advertising is not being used. A bulletin is posted and a news item giving the time and place the locomotive will be shown is sent to local newspapers for such use as they may care to make of it.

Each day the locomotive is moved to a new community. In the first 11 cities in which it was shown in the Eastern region 103,347 people visited it. These cities had a total population in 1930 of 541,721, so that a goodly portion of the citizens was sufficiently interested, even under the extremely hot weather conditions, to go out of its way to see the locomotive. In Renova, Pa., a city of 3,947 inhabitants, according to the 1930 census, there were 4,026 visitors. At Lock Haven, Pa., 5,368 people examined the locomotive, the population of that city being less than 10,000.

What is being accomplished? "We are letting the public know that the railroads are progressing and keeping up with the times," said Walton Wentz. "I got this from conversations with those around the engine, whether they are 10-year old children, old men and women, business men, politicians, ministers, just plain hangers-on, and all who come to see the engine."

Another illustration of the fact that the public can readily be made more actively railroad-minded is the remarkable results which have accompanied the celebration of Railroad Week in the middle and western sections of the country. First tried last year, it was entered into so enthusiastically that it was again repeated this year and with even better results.

Railroads can utilize new or rebuilt locomotives to excellent advantage in cultivating the public and bringing about better understandings.

## **Shop Report Includes Important Conclusions**

The report on consolidation and modernization of shops, which was issued on June 12 by the Federal Co-ordinator of Transportation, contains information of vital interest to mechanical department men who are concerned with the problem of maintenance of equipment.

Included in this report are the results of studies which have been made by various groups reporting to the Co-ordinator in recent months, as well as substantial information which emphasizes the magnitude of the problem with which the mechanical department must deal. While the report makes no recommendations for specialized action there are certain general conclusions that are of special significance.

Included in these conclusions are two statements of

special importance in relation to the equipment of locomotive and car repair shops. These are that "the continued use of obsolete facilities results in high costs of maintaining equipment not only in respect to actual work performed but also in respect to the quality of the work" and "no general program for replacing shop machinery should be adopted until a sound and balanced plan has been worked out in respect to the average condition of the locomotives and cars, repair schedules required to maintain that average, and the kind and location of repair facilities needed for the purpose."

In commenting on the maintenance of equipment problem, it has been consistently pointed out that cost of repair work in railroad shops is greater than need be because of the fact that such a large proportion—65 to 70 per cent—of the machine tools in the average railroad shops is considerably more than 20 years of age, and consequently unable to compete with modern machine tool equipment in efficiency of production, not to mention the fact that the advanced age of such machine tools necessarily involves large annual expenditures for maintenance.

It has also been pointed out that before any general program for replacing shop machinery is adopted, the problem of repair work on individual roads should be very carefully studied with the idea of developing information in considerably greater detail than has been the case in the past. Experience with machine tool replacement programs indicates that in so far as railroad shop machinery is concerned, there are certain types of machines which will produce a far greater return on the investment than other types due presumably to the fact that it is possible, because of the nature of the work, to use them more nearly to capacity.

The Co-ordinator's report points out the magnitude of the problem and gives us an excellent idea of the manner in which savings in equipment maintenance may be effected. It is important, however, for railroad men to realize that the obsolete facilities which are now in service in the shops are costing their companies money as long as they are continued in service, and that the manner in which these obsolete facilities can be replaced to the greatest advantage will depend upon the intelligence with which the replacement program is developed.

Included in the report are figures which indicate that over a 12-year period, from 1920 to 1931 inclusive, an average of \$23,700,000 a year was expended for repairs on shop equipment involving a total investment of some 23 million dollars and that a substantial reduction of this amount might be effected, if a general policy of renewal of all machine tools was so planned that the average age of such tools would not exceed 7½ to 8 years, with an ultimate life of 16 years instead of 21.8 and 43.6 years respectively. The extent of the reductions in expenditures, chargeable to Account 302—Maintenance of Shop Machinery—is based upon the fact that the present expenditures amount to an average of 7.4 per cent on the investment, whereas

experience in industrial plants has indicated that with machine tools having an average age of 10 years or less, the annual expenditure for maintenance should not be greater than 1.2 per cent on the investment.

Numerous studies which have been made indicate that the percentages involved, namely, 7.4 for the railroad shop and 1.2 for the industrial plant are accurate, and that a broad program of machine tool replacement resulting in a reduction in average age to from 10 to 15 years would result in savings in machine tool maintenance costs in the neighborhood of from 4 to 5 per cent on the investment. It is important, however, in making use of the general figures relating to the railroad industry, to point out that the figures relating to investment in shop machinery and maintenance of shop machinery include other items of shop facilities than machine tools. An examination of the details of Account 302 particularly, will show that this account includes not only repair expenses on many items of shop machinery other than machine tools but in most years this account has included substantial amounts which have been charged as a result of retiring old machine tools.

The important point in this connection is that because no detail figures are kept by most railroads relating to repairs to shop machinery, the extremely high cost of maintaining obsolete machinery has not been readily recognized. The amounts which have been so expended are sufficient to pay a very substantial part of the cost of replacing machine tools or shop equipment which have outlived their usefulness.

## NEW BOOKS

**HENSCHEL REVIEW.** *Published by Henschel & Sohn A. G., Kassel, Germany. 100 Pages, 8½ in. by 11½ in. Printed in English.*

The last edition of Henschel Review, No. 5, December, 1935, is of special interest as it commemorates 100 years of German railways and 125 years of continuous operation of the company, which has constructed more than 23,000 locomotives. The first page shows in striking contrast the locomotive "Drache" built in 1848 and the latest German high-speed streamlined locomotive. In addition to well illustrated review articles on 100 years of German railways and express locomotive developments in the past 50 years, there are many illustrations of locomotives recently built. Other timely articles of particular interest cover a world wide illustrated review of streamlining (historical and recent); factors relating to and determining the application of steam, electric and internal-combustion locomotives; streamlined steam rail cars and locomotives, for the Lubeck-Buchen Railway; steered locomotive trucks; a condensing reciprocating steam locomotive for Russia; and the new standardized locomotives for the Chilean State Railway.

# Gleanings from the Editor's Mail

The mails bring many interesting and pertinent comments to the Editor's desk during the course of a month. Here are a few that have strayed in during recent weeks.

## Quiet Place for Conference

Recently I heard the following remark in the office of the erecting shop foreman:

"Let's go down to the boiler shop office; it is too noisy here for our meeting."

As an actual fact, due to the extended use of pneumatic tools, there is frequently found to be much more noise in the erecting shop than in the boiler shop, where the quieter operations only are performed, such as laying out, rolling, flanging, fitting up and staying. The noise-creating operations appear to be performed now in the erecting shop.

And so the boiler shop office was chosen for the conference!

## Old Plant Speeded Up!

There are many opportunities to improve shop operations. Old plants have been rejuvenated, not only by the acquisition of a number of new tools but by the application of electric power replacing the old steam plant. I have in mind a locomotive shop, 45 years old, which, by simply uncoupling the main line shaft and applying motors at subdivisions and countershafts, made it possible to increase the speed from 80 r.p.m. to 200 r.p.m. The current was secured from a traction line at a low price by keeping off peak. You can imagine the result in efficiency and reduced cost. The whole change was made at a very moderate expenditure.

## Threatened Shortage of Skilled Workers

I like to read your articles on apprenticeship. I believe we are heading right into difficulties, due to a shortage of railway craftsmen. I believe that if I was instructed to suddenly increase my staff of mechanics 10 per cent, I could not do so with competent men. I know of no railway blacksmiths out of work, nor in work who would quit and come to a railway shop under present conditions. Good pipefitters also are scarce. I could pick up a few boilermakers; welders are capturing some of the jobs from boilermakers. Machinists would be difficult to get unless you took them away from another railway. We have always managed to regulate our apprentice system so that it would balance our payroll separations, but if the retirement pension at 65 goes into effect, extra railway craftsmen will be hard to find.

## The Boilermaker Speaks

Jones, the boilermaker, called attention to the merits of welded flues, making it possible for locomotives to stay on the road on extended runs of 24 hours, or more, and reach the terminals with no leaks to speak of, anywhere about the firebox. And the proper treatment of the boiler feedwater is a great factor in making every locomotive a free steamer and easy on the coal pile. He mentioned the fact that in the old days, before feed-water treatment was the practice, it was a common thing to bush the exhaust nozzle to provide stronger draft on the fire to make up for the loss occasioned by the accumulation of scale on the flues and firebox sheets, which was often  $\frac{1}{8}$ -in. to  $\frac{1}{4}$ -in. in thickness. Bushing down the exhaust nozzle increased the back pressure and the fuel record went glimmering. After all, there is nothing like a clean boiler to make engines show up good on fuel performance and the lower maintenance costs of firebox repairs more than offsets the expense of treating the water.

## Principal Source of Information

As you know, the financial condition of our railroads has prevented supervisors visiting other shops for exchange of ideas and practices, and our principal source of knowledge of improvements on other lines is necessarily limited to what is published in your magazine.

## How About the Answers?

I am more interested, personally, in articles dealing with design and maintenance of present equipment. Questions similar to the following are always suggesting themselves:

What changes can be made in drafting appliances, or grates, or both, to make a better steaming and a more economical engine?

When you get back pressure down reasonably low is it an advantage to go lower at the expense of superheat?

Is it good practice to superheat much above a point where exhaust steam carries superheat?

Are floating bushing driving boxes and solid tip ends an improvement over the old style crown brass and split tip end brass?

## Hot Engine Truck Boxes and Hot Rods

The cellar packer, who is known around the roundhouse as the "lubrication expert," says it is now a rare occurrence to cut out an engine on account of a hot truck box, since the engines on the long runs have been equipped with the new style cellars on the engine trucks and trailers. He further states that the 'hot rod' proposition is well in hand since the rods have been equipped with the new style rod cup fittings and it is so much quicker to fill rod cups with the new air-operated grease gun, as compared to the old screwed plugs and the wrenches used by the hand method.

## Why Long Locomotive Runs Are a Success

Recently I overheard a discussion that arose a few minutes before the whistle blew to start the shift, and talk centered about the thing that the men thought most beneficial in making the extended locomotive runs successful. The gang boss thought it was for the most part made possible by the new set-up of giving engines classified repairs at regular intervals. Also the fuel performance was materially helped by having the bore of the cylinders and the valve chambers in first-class condition. It was thought that the increase in the miles run per engine failure was also due to good inspection being made while engines are being stripped for repairs.

## Cultivating the Public

Of course, I recognize that the curious were there (visiting the Pennsylvania Railroad's new streamlined, coal burning passenger locomotive recently completed at its Altoona works); also hundreds of little children in every town. I checked the faces of these little run-about children at two points. I saw them at the engine in the forenoon. I think it was in Williamsport in the evening that I heard a little fellow say, "There's the man," and when I looked around (out of pure curiosity on my part) he was pointing at me, and it was a little chap to whom I had been talking in the morning. I had simply said, "Run up there, Sonny, and look in the engine cab and see where the engineer sits." There he was in the evening, all cleaned up, hair combed, 'n' everything, and his father and mother were with him, all freshly dressed for the evening. They were "the public"—in other words, I asked a friend of mine who knew the man whether he was a railroader and he said the man was in business.

## IN THE BACK SHOP AND ENGINEHOUSE

### Bronze Welding And Brazing\*

By Homer Gannett

In the past 15 years we have witnessed the rapid development of bronze welding and brazing. These developments have been in both the oxy-acetylene and the arc-welding processes. This progress, however, has not been accomplished without many experiments and some failures.

In the early stages of brazing of cast iron, we met with some difficulty in obtaining the proper adhesion to the castings. This brought about the question of a good chemical flux that would act as a scavenger, removing all foreign substance, and thus permit the bronze to adhere to the metal. We also found that the surface must be properly prepared; fractures and breaks must be beveled; and sufficient clearance provided to permit the bronze to flow through the entire section. In many cases, it is essential to preheat the casting to obtain the proper expansion to allow for the contraction of the weld.

Through these experiments, brazing and bronze welding is fast becoming an art recognized by many railroads as a standard procedure of reclaiming broken and worn material; also for building up worn surfaces with attendant large savings and economies in shop operation.

I would like to point out a few reasons why brazing will increase production at a saving. The rapid rate of deposition, which is several times greater than with any other metal, reduces the labor time, and the material being brazed or bronze welded is subjected to the least amount of heat possible. This tends to minimize the amount of internal stress within the welded area.

Several years ago we did not think that the brazing of broken locomotive cylinders would ever be successful, but we find that this operation is today very satisfactory in most all cases. However, there are some locations in locomotive cylinders that are very difficult to braze. This is due to the unequal expansion and contraction as well as the difficulty in reaching these locations. We also find that many emergency jobs that cannot be held long enough to weld with steel, are satisfactorily brazed. This pertains to running repair work, such as frames, etc.

Many railroads find that the reclamation of malleable car parts are more satisfactory when bronze is used. This is due to the fact that the bronze is applied without raising the temperature of the malleable to the critical point. Therefore, the structure of the malleable is changed very little.

We also find a large field for bronze welding, and brazing on bearing parts, such as the jaws of valve motion parts; crosshead shoes (cylinder and valve); welding on brass liners to driving boxes; both hub and pedestal, and other such parts.

The general procedure in bronzing worn crosshead shoes is to apply a bronze rib about two inches or wider on each side and one or two in the center, and fill in between with babbitt. However, I have witnessed a very satisfactory method on Laird guide shoes where the shoe is forged of steel and then faced with bronze. This

method in many cases is more satisfactory than the solid brass shoe. Due to the difference in expansion, the steel faced shoe can be set up with less lateral; therefore, it should create less hammering.

We also find that many railroads are successfully bronzing worn piston heads and bull rings. This success depends largely on the preparation of the work before being bronzed; also, on the skill of the operator in applying the bronze without burning it and yet obtaining good adhesion.

Piston heads saturated with oil are difficult to bronze and obtain a solid deposit. A porous deposit of bronze reduces the bearing surface considerably. Therefore, I believe that the success of bronze welding and brazing is assured only when the material is properly prepared and the welding and brazing performed by a qualified operator.

### Stopping Small Losses Results in Large Savings

By W. B. Foster

We are inclined to think always of value as money and to look upon material other than money as being simply different kinds of matter kept for convenience and to be used freely whenever and wherever desired. Yet we know that a man with a home paid for and but one dollar in cash to his name is wealthier than his neighbor with a hundred dollars in coin and no other possessions, wealthier because the quantity of other material he possesses has more value than the quantity of the material called money.

Money is only one of the many different kinds of material in existence. For centuries people lived, increased, and thrived without it. Trade was based on comprehension of the value existing in all kinds of material and the part each plays in contributing to man's wealth and prosperity.

We are likely to think of sand only as dirt; paint as



Here is half a dollar picked up casually on the way to the roundhouse

\* Presented by Homer Gannett, welding supervisor, Chicago, Burlington & Quincy, at the Midwest Welding Conference, held under the auspices of the Hollup Corporation at Chicago on June 5.

merely liquid; rope as strings of wool and cotton; gaskets as bits of rubber; rivets, rough metal; unions, cold iron; rails, cold steel; boards, just wood; globes, thin bits of glass; machines, assemblies of metal; buildings, convenient shelters. We search hard for a lost nickel and walk straight by a leaky oilpipe that will let many nickels drip away forever. We never allow small change to lie scattered over an engine, but we let the same engine go out with material on the deck, the bumper and the running boards, to be jarred off and lost along the right-of-way.

This carelessness is a paradox of human nature, but we do comprehend the value in materials and often display our realization of it unconsciously. If we are given the choice of a dime or a good dinner we take the materials on the table and call it a cheap price for a meal.

We know, from our own experience that every kind of material is value. No matter whether we call it a dime, a poker, a bottle, a tire or a chair, each piece of material has a certain worth to obtain which we have to give something in exchange. As long as we have it or its equal in value the worth of our possessions remains unchanged. But if we consume it or lose it or waste it we reduce the worth of our property accordingly. This is why such strenuous efforts have been and are continually being made on the railroads to find ways and means to save material. It is one of the major steps toward preserving the value of the company on whose worth our livelihood depends.

True saving of material is not accomplished by being stingy with it. Keeping it on the shelf when it ought to be used may result in failures and trouble that will

somewhere neglected a crack in a car roof, the fastenings of a car seat, a split rung in a ladder, or some other defective condition. "A stitch in time saves nine," and we should use whatever material is necessary to proper operation and maintenance.

### Reducing Necessity for Use a Real Saving

The requirement of a real saving in material is to find ways to reduce the necessity for using it. This can be accomplished, first, by doing away with unnecessary facilities and equipment, and second, by eliminating conditions which involve waste of material that does have



A rod bushing, before and after the pattern was changed to eliminate the purchase of unnecessary material and waste of time in machining it off



It took three minutes to pick this thirty-three cents off the "scrap-pile tree"

cost many times its value. Letting the loose ends go frays out the warp; a rip unmended lengthens; a bolt applied without nut or cotter is soon lost. Incomplete repairs leave open the door to failures that lead not only to waste of material but also to other loss of property and to personal injury. Many a dollar has been paid in claims for damaged freight or clothing or in compensation for personal injuries, because someone

to be used. These methods not only result in actual reduction of expenses but also (and here is where the great benefit comes in) make the savings continuous and permanent. They do not save today and lose tomorrow, but get at the root of the trouble and establish a saving that repeats itself day after day. Any other means is but temporary relief; finding the way to reduce the need for material is a permanent cure. Let us look at a few cases from actual experience which illustrate the scope of opportunities for making such cures.

In one train yard were nine toilet buildings, averaging one for each switching crew employed there. The yard was not very large and furthermore was adjacent to a shop with ample washroom facilities for all employees in the vicinity. The building farthest from the shop was left, the other eight were removed. They were a source of unnecessary expenditures for construction and maintenance as well as of fire hazard and of dangerous obstruction to employees working throughout the yard.

Certain appliances on locomotives were equipped with valves which by reason of their location were frequently knocked off and broken. Replacements cost several dollars each. A way was found to operate properly without them and they were removed permanently, saving not only the cost of the repeated replacements but also the loss of man-hours and engine service which was resulting from tying up the locomotives for repairs.

(Continued on page 362)



# THERE IS A RULE

**"D**ID you see that message from Lane about the 5079?" John Harris, the roundhouse clerk, asked.

"Yes, I saw it," Jim Evans the roundhouse foreman bit off a slug of "horseshoe." "I guess everybody else on the railroad saw it, too. It's a wonder he didn't send a copy to President Roosevelt while he was at it! He sent copies to every one else he could think of," Evans added.

"Yes, I noticed there were copies to the master mechanic, superintendent, and superintendent of motive power. Looks like he wants to advertise it all over the railroad when an engine comes in from Plainville needing a little work," Harris said. "I have an idea we have engines come in here from Sanford in lots worse shape than with a broken spring hanger," the clerk added.

"Not to hear him tell it! According to him the reason his M. of E. charge runs up is because of so much work on engines we dispatch from Plainville." Evans had his mouth so full of tobacco juice that he was beginning to gurgle. He fished the cuspidor from under the desk with his foot and expectorated a lusty stream. "Yeah, if Lane was half as anxious to get the work done on engines as he is to holler about what we don't do, we'd all get along better."

"They all belong to the S. P. & W., don't they?" Harris stated rather than asked.

"Yeah, they all belong to the S. P. & W., but Lane likes to make a showing. He figures that by shooting all power back here that needs work he can keep his own costs down and by hollering his head off about work needed on locomotives we dispatch he'll make everybody think he could do still better except for

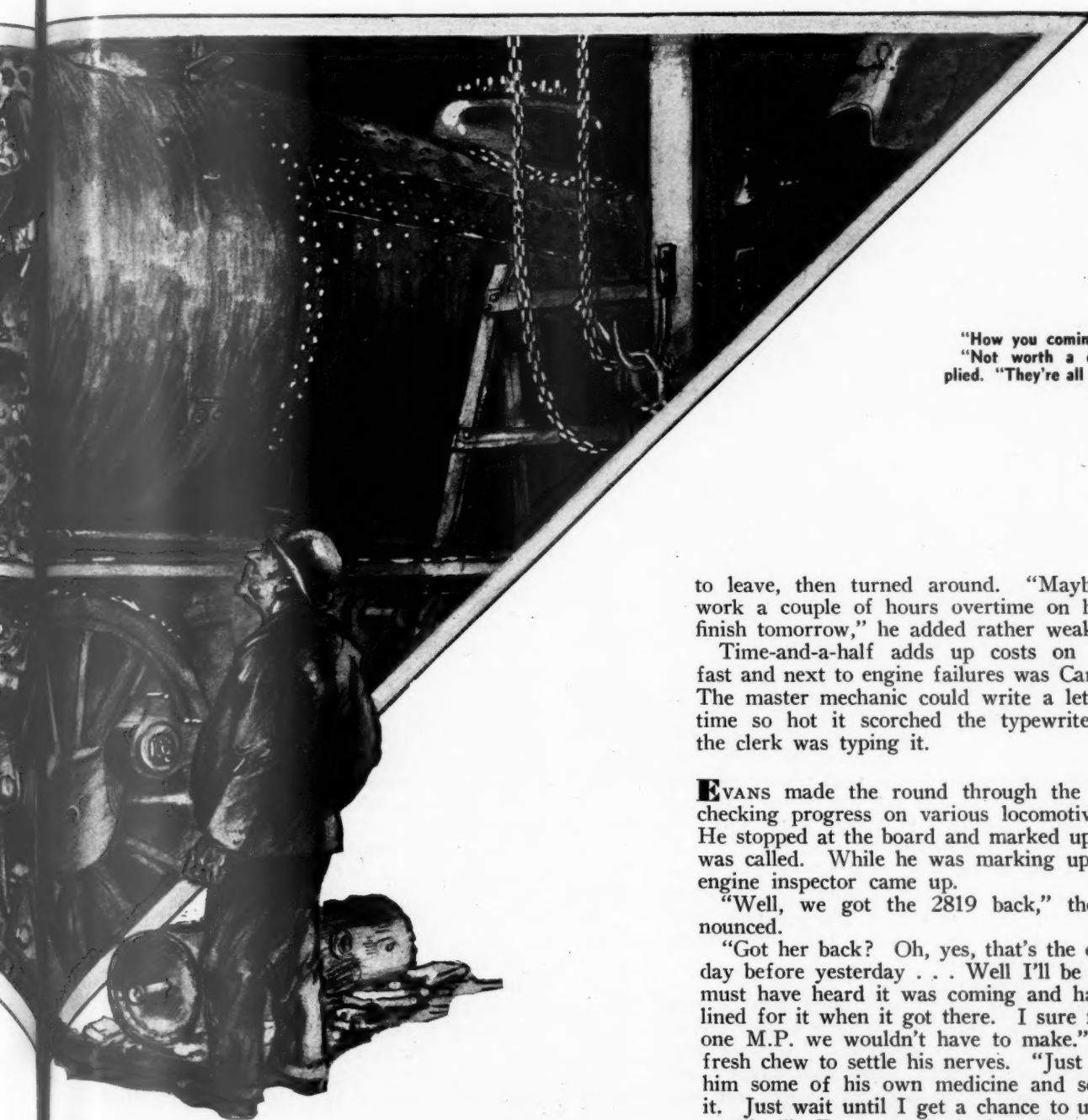
*by*  
**Walt  
Wyre**

having to do work we should do here. I'm getting blamed tired of it, too! Why, it's getting so that Lane figures to a minute on getting engines back here for M.P. inspections. The 5080 that came in on No. 9 at 10:50 last night was due an annual at midnight. Huh!" Evans snorted and headed for the roundhouse.

The foreman went by stall number 12 to see how the boilermakers were getting along with the 5087. The engine was in for a five-year test. The jacket and lagging had been removed. Barton was taking off flexible staybolt caps. The boilermaker was pulling, panting, and swearing. Pulling on a buggy bar inserted in a box wrench was making him pant and a staybolt cap that wouldn't budge was causing him to swear. The boilermaker heaved and grunted, but to no avail. He slammed the wrench and bar down and grabbed hammer and chisel. He finally managed to jar the cap loose, but not until he had cut two corners off the cap and left a deep gash on a third.

"How you coming?" Evans asked.

"Not worth a damn!" Barton replied. "They're all



"How you coming?" Evans asked.  
"Not worth a damn!" Barton replied. "They're all tight as thunder—"

to leave, then turned around. "Maybe you'd better work a couple of hours overtime on her so you can finish tomorrow," he added rather weakly.

Time-and-a-half adds up costs on repairs mighty fast and next to engine failures was Carter's pet peeve. The master mechanic could write a letter about overtime so hot it scorched the typewriter ribbon when the clerk was typing it.

**E**EVANS made the round through the house mentally checking progress on various locomotives as he went. He stopped at the board and marked up an engine that was called. While he was marking up the board, the engine inspector came up.

"Well, we got the 2819 back," the inspector announced.

"Got her back? Oh, yes, that's the one we run east day before yesterday . . . Well I'll be damned! Lane must have heard it was coming and had the turntable lined for it when it got there. I sure figured that was one M.P. we wouldn't have to make." Evans took a fresh chew to settle his nerves. "Just wait! I'll hand him some of his own medicine and see how he likes it. Just wait until I get a chance to unload something on him!" Evans strode back to the roundhouse office swearing under his breath and spitting every third step.

"Dispatcher wants a 5000 for a drag east at four o'clock," the clerk told Evans when he reached the office. "What'll I give him?"

"Well, let's see. We got to use the 5072 on the Limited and the 5081 on 71. Wouldn't the dispatcher take a 2800?"

"No; I asked him. He said there would be too much; have to have a 5000."

Evans slumped down in a chair to think the situation over. "I've got it!" he announced. "We'll use the 5091."

"But I thought you were going to hold her for a set of tires," Harris reminded him.

"I was, but we'll just let Lane have her. The driving-boxes are pounding, too. Just make a wire to Lane telling him about it. He sent her up here; I'll just be as good as he was, and send her back to him." Evans chuckled and leaned back in his chair.

About ten o'clock next morning the messenger laid

tight as thunder—have to use a hammer'n chisel on every one of 'em." The boilermaker glanced at the scarred remains of the cap in his hand.

"Well, get it done soon as you can. We need that engine right now—need it bad. Do you suppose you can get it done so the coppersmiths can start putting the lagging and jacket back on tomorrow?"

"'Fraid not; we could if we had one of them impact wrenches, though."

"What do you mean, those new wrenches we saw advertised last month?" Evans inquired.

"Yes. They're just the thing for a job like this—get it done in half the time and lots easier, too. Why don't you talk to the master mechanic about ordering one. There are lots of places it would come in handy around here, save a lot of money," Barton added, knowing that the economy angle would be more likely to get the wrench than the fact that it would make the work easier.

"I'll see about it," the foreman said, and started

a message on the clerk's desk. Harris read it and handed the yellow slip of paper to Evans: "Engine 5091 in Sanford this date. Driver tires worn to limit, driving boxes pounding bad. Rod bushings need renewing."

The message was from the foreman at Sanford. In the lower left-hand corner was marked: "cc-F.R.Rines; H.H.Carter."

"Lane didn't waste any time letting the superintendent and master mechanic know about the 5091," Harris observed.

"Lot of good it'll do him. He sure won't have the gall to send it back in the shape it's in. If he did and a government inspector happened along, it would be just too bad." Evans grinned at the thought as he sat down to look over some work reports before taking them to the roundhouse.

Just as the foreman was starting to leave, the phone rang. The foreman paused a moment to find out who it was and what was wanted.

"They want a 2800 for a work train in the morning; be out all week or longer," the clerk said.

"People in Hell crave air-conditioning, too!" Evans replied. "Tell him I'll have to look things over and let him know later . . . Already two engines short and they decide to run a work train! A person would think the way they go off half cocked sometimes that the Government was running the road." The foreman headed for the roundhouse in high spirits in spite of the shortage of engines.

After looking things over, Evans decided on the 2822 for the work train. It wasn't quite ready to fall apart, but still wasn't in shape for heavy road service.

In stall number 12, Evans found work on the 5087 progressing as well as he expected. A coat of red lead had been applied to the boiler and the engine was ready for the asbestos lagging. If things went O.K., he could get it out in time to run the next night.

The 5076 came in on No. 10 dragging like a mechanic with a Monday morning hangover. "The blamed engine hasn't got power enough to pull a drunk brakeman out of service!" the engineer told the foreman. "Cylinder packing down."

Evans asked, "Which side?"

"Which side? The way it acts, there ain't no rings on either side. Both sides are blowing so bad the engine don't exhaust, it just whooches. And the right valve, too, it's just as bad. Then they wonder why we can't make time!" The engineer snorted and went in the wash room.

Evans went in the office. "How's it going?" he asked the clerk.

"There'll be two sections of No. 9 tonight," Harris told him, "and the dispatcher wants a 2800 for a stock pick-up east at 4:30."

"Well, looks like we might be a little short on power tomorrow, but we ought to make it. I'd better have the hostler get the 5076 in the house right away so they can get started to work on her."

After lunch, Evans, as usual, made a tour of the roundhouse. Machinist Jenkins had pulled both pistons from the 5076 and was starting on the right valve.

"How does she look?" the foreman asked.

"The packing is down on both pistons, pretty bad. I don't know how the valve is. I'll have it out in a little bit."

At that moment Jenkins' helper returned with a package in his hand. "They didn't have but one set of piston packing in the storeroom," the helper announced as he laid the package containing the sectional packing rings on the pilot beam.

"What we going to do about that?" the machinist asked.

"Nothing we can do except put in the one set and wait until we get another. Soon as we see what the valve needs, I'll go down and have the storekeeper send a hot wire about it."

"Need new valve bushings," Jenkins said when he and his helper had pulled the right valve piston out.

And it did need new bushings. Both front and back were badly cut out. The valve showed signs of having been blowing badly.

"I'll have valve bushing castings sent to the machine shop while I'm at the storeroom," Evans said as he started away.

He didn't have the castings sent from the storeroom for the very good reason that there weren't any to send.

"Shall I go ahead and get the bushings cut out?" the machinist asked.

"No; put in the set of cylinder packing and let the rest go for the present. You and your helper can go down to the 5087 and help get her out. Looks like we're going to need her before she's done."

**N**EXT morning things started off all haywire and from there got worse. There was a message saying that the engine on the work train had a bad leak in the fire-box and would have to be relieved for repairs. There was another message that didn't cheer Evans up any. It was a notice from the foreman at Middleton, the west end of the division, saying that the government inspector would probably be in Plainville that day. Then just to add variety to the general mess of misery that was being cooked for serving that day, the 5074 had failed on No. 10. A crank arm broke and the eccentric rod slammed things around quite a bit before tying itself in a bow-knot.

"Now if we can just manage to get a couple of Form 5's, that ought to help a lot," Evans said sarcastically and bit off a hunk of "horseshoe."

The government inspector showed up about 10:30. Evans was out in the roundhouse at the time pushing work on the 5086. Mechanics were hurrying helter-skelter looking for parts and fittings that had either been mislaid or used for repairs on other engines. The painter was trying to spray the jacket amid a barrage of profanity from mechanics that were in his way. The electrician was threatening to start throwing things if the painter didn't stop or turn the spray gun in another direction.

"Just a nice happy family," the government inspector remarked grinning.

"Yeah, oh, hello, Mr. Turner! Glad to see you," Evans lied glibly. "Just a moment and I'll be ready to go with you soon as I get things organized on this Tower of Babel."

"Don't you want to go to the office and slip on some overalls?" Evans asked when he and the government inspector had started down through the house together.

"No, not now," Turner replied. "I'm going up to the hotel and make out some reports. I'm not going to bother you much this trip. I may drop back a while this afternoon."

"Won't you go out to the house with me for lunch?" the foreman invited.

"No, thanks, I'll have a bite up town."

"Well, I'll tell the wife you'll be out for dinner then," Evans suggested.

"Thanks again," Turner replied, "but guess I'll have to take a rain check and make it some other time. I'm getting out this evening, going east."



At the lunch room he ran into the government inspector.

"Sorry you can't come," the foreman replied, immensely relieved, not because Turner had declined the invitations to eat but because he had learned that the government inspector's plans didn't include a fine toothed inspection of the locomotives at Plainville.

Turner had been gone about twenty minutes when a 5000 whistle announced the arrival of a westbound drag. Evans at his desk cocked his ear to listen. There was something vaguely familiar in the tone of the whistle, but the foreman didn't recognize the engine. At times he could recognize locomotive whistles in spite of them being standardized and operated by automatic whistler blowers.

A few moments later the drag pulled in the yard. The locomotive came clanking by the roundhouse. Then Evans swore—vehemently and volubly. At the head end of the drag, puffing derisively, was the 5091, worn tires, pounding driving-boxes and all. Lane had taken a chance and sent the engine back to Plainville.

"Of all the blasted nerve—sending that engine back here in that shape! Make a wire to Lane with a copy to everybody on the railroad telling about it. Make it plenty strong!" Evans fumed.

Harris reached for a pad of yellow clip. Pencil poised over the paper, he waited while Evans sat with puckered brow eyeing the floor. "What shall I tell him?" the clerk asked.

"Tell him the 5091 in Plainville from Sanford this date in very bad condition, tires worn past the limit, driving-boxes worn, and other Federal defects . . . Wait a minute; tear that up! It sounds too much like the way Lane does, too much like snitching. Besides, I've got a better plan."

Harris crumpled the paper in a ball and tossed it in the waste paper basket.

"What time is the next one going east?" Evans asked.

"There's one doped for 1:30. Ought to get a call on it any minute now. It's a fruit train and will have to get over the road," the clerk reminded him.

"That's O.K. The 5091 will run if it don't fall to pieces. I'll just send her right back to him. Turner will be there tomorrow and Lane won't dare try to run her. If he does Turner'll slap a Form 5 on her so hard it'll bounce. Serve him right, too. Lane, I mean, for the way he's been dodging work and scattering carbon copies of messages over the railroad. That'll fix him!" Evans said emphatically.

"Yeah," Harris replied, "if he gets a Form 5, it'll teach him something. They sure are getting hard about Form 5's on this railroad."

"Well, when the dispatcher calls, give him the 5091," Evans said and left for a turn through the roundhouse.

SOMEHOW Evans didn't feel as elated over the prospects for getting even with Lane as he thought he would. Even reminding himself of the many things the foreman at Sanford had pulled on him didn't entirely satisfy his conscience.

Without knowing exactly why, Evans decided to go to lunch early and on impulse decided to eat in town. He called his wife and told her not to look for him and about 11:30 went to town.

At the lunch room he ran into the government inspector. "Sit down," Turner invited. "Thought you were going home to lunch."

"Changed my mind. Don't want anything but a cup of coffee and a piece of pie. My wife always gets anxious when I don't eat," Evans explained. "I have my car; if you will be ready to go back to the shop, I'll take you down," he added.

"No, I won't be down for a couple of hours. Didn't finish my reports and want to get them off first. You're too anxious," Turner added jokingly. "I'm afraid Lane won't be so glad to see me, though."

"Oh, I don't imagine he'll mind. You're not so bad, if a man gets the job done," Evans replied.

"That's just the trouble. I've warned Lane several times. He's had plenty of chances and the railroad officials know it, too. About one more Form 5 and it'll be too bad. I'd hate to have to do it, but if I have to, I will."

Evans finished his pie and coffee. "Say you're not ready to go to the shop?"

"No; see you later on."

Evans didn't linger. He rushed back to the shop. The 5091 was on the outbound track waiting for the engine crew.

Evans pictured in his mind just what would happen in Sanford. The 5091 would get in early next morning. She'd be setting outside when Lane came to work. Running true to form, Lane would give orders for the engine to be turned and run west. Knowing Turner's habits pretty well, Evans figured that the inspector would reach the roundhouse just about time the 5091 was set out on the lead, then wham! A Form 5 so quick it would make Lane dizzy. Evans frowned and bit off a hunk of "horseshoe." There wasn't another engine ready or that could be gotten ready.

The twelve o'clock whistle interrupted his meditation. He turned on his heel and headed for the office. Employees were already beginning to check out when he got there. He looked down the line of overalled men. "Here, Jenkins, and Williams," he called to two machinists. "You and your helpers work noon hour on the 5076. Get her back together ready to go. I'll be with you in a minute."

"Call the dispatcher and tell him to change the engine on the fruit train, I'm using the 5076," Evans told the clerk.

"Reckon she can make the time?" the clerk asked.

"I kinda doubt it, but we'll take a chance, and give the engineer a note to Lane telling him the government inspector will be there tomorrow with blood in his eye," Evans added as he left.

Somehow the letter Evans received about the 5076 losing two hours on the run didn't have the sting such letters usually have, even if it wasn't written any different.

## Stopping Small Losses Results in Large Savings

*(Continued from page 357)*

Counting certain small items to check receipts against invoices took much time because of the number used. The units were of uniform size and it was found that the number could be ascertained accurately and many times more quickly by weighing instead of counting.

Part of the roof of a building loosened; a gust of wind completed the loosening process and ripped off some boards. In falling they narrowly missed a man who had just come out of the building; they splintered into matchwood; and so much rain poured through the hole that work was badly hampered and part of a job

spoiled. All this danger and damage would not have occurred if, when the boards were first loosened they had been nailed back into place. Cost of new boards, loss of man-hours, expense of duplicating the job that was spoiled, all could have been avoided.

Three metal buildings were erected for a certain purpose at three widely separated points. Two of the buildings were kept painted; the third was let go. Rust got in its work so that it was necessary finally to renew the entire roof and most of the sides of the latter at a cost many times the value of the paint and the labor which had been put on the other two buildings, both of which continued in excellent condition.

Check of a certain casting showed the pattern was much too large. A change in the dimensions reduced the weight 40 per cent, which not only cut down the original purchase price but also saved much labor in handling and in machining to fit when used. The annual saving in purchases on this one casting was about 16,000 lb.

Another casting had a heavy boss or projection on one end to fit into a pocket of the equipment on which it was used. The pocket had later been eliminated but the casting had not been changed; the result was purchase of extra material which only had to be machined off before the casting would fit. Changes in this pattern produced decided savings in both material and labor costs.

A complete check of all castings uncovered similar conditions correction of which eliminated the purchase of thousands of pounds of material annually and saved hundreds of man-hours formerly consumed in machining away the surplus stock.

A requisition was submitted for two panelboards for electric-light switches, due to the boards in use being too small to accommodate added switches required. Check-up showed that added space was needed as stated in both cases; but it also showed that one board was much larger than the other and could be used to replace the smaller board and thereby leave but one panel to be purchased.

A welding job was conducted under one of the two main processes used today. A study showed that in this particular work the other process was much more economical. The change saved thousands of dollars annually.

An oil reclaiming process required blotters which had to be replaced after being used a few times. Investigation showed that a different grade of blotter was more economical not only in first cost but also service obtained. An old axiom says: "The best is always the cheapest." Here was a case where the cheapest was in every respect the best, the blotter which proved most suitable being the lowest-priced among all those tested.

Rods, pipes, and other parts headed for the scrap pile were found to be carrying with them good fittings such as plugs, valves, and similar items. A program of reclaiming these items netted a considerable saving.

A moving part made of brass required frequent replacements. The casting was changed to steel with brass lining which could be rebuilt when worn. The result was the complete elimination of new purchases of the castings, with only the expense of relining as required.

At one point water was being purchased at a cost of several hundred dollars a month. A well was driven and an automatic pump installed which supplied the same amount of water thereafter at a saving of about 75 per cent of the cost when purchased. A similar check at another point developed a saving of about 85 per cent.

It was found that a good scrubbing will frequently

take the place of a paint job, removal of dirt being often all that is necessary to freshen up a surface. As soap is much cheaper than paint this produced decided savings in renovating cabooses, stop-blocks in round-house stalls and other equipment.

The annual bill for certain oilcups ran into four figures. Now these cups have a very easy job. They just go along for the ride, doing no hard work, under no strain, with no moving parts or complicated mechanism, with only a tiny hole in the center through which the oil feeds. Why, then, should they be replaced so often? To find out, each man applying them was requested to turn in the old for the new so they could be examined for failure. The chief defect was holes plugged up. All concerned were specially lined up to keep cups cleaned; the result was almost endless life for the cups and reduction of purchases practically to zero.

This item answers a question that has been asked many times: "Why is it necessary to turn in this or that old material when new is drawn out?" Requiring old material for new is just one step in the primary requisite for reducing bills, namely, to find a way to reduce the necessity for purchases. To learn why a thing fails obviously necessitates finding out what is wrong with it. To do this necessitates examining it. Thus we find, perchance, weak construction at some point; defective material in some section; evidence of unfair usage; indication of excessive heat, pressure, or other abnormal condition; a variety of clues that help to solve the puzzle of why we use so much of a certain item. Having determined why it gives trouble, we can take steps to correct any wrong condition and thus get more service out of it. Consequently we do not have to buy new units so often, and the benefits of a new saving begin to appear.

There are some kinds of material of which the used are required as a check against loss by theft. Electric bulbs, putty knives, tapelines, and thermometers are in this class. Such articles are of common use, handy around any house or in any business. It would be a simple matter to tuck these away and remove them from the railroad property if there were no close check kept on the reason for the replacements.

Waste is a drain on any treasury, which, if too long unchecked, will end in bankruptcy.

## Rapid Grinding Technique For Carbide Tools

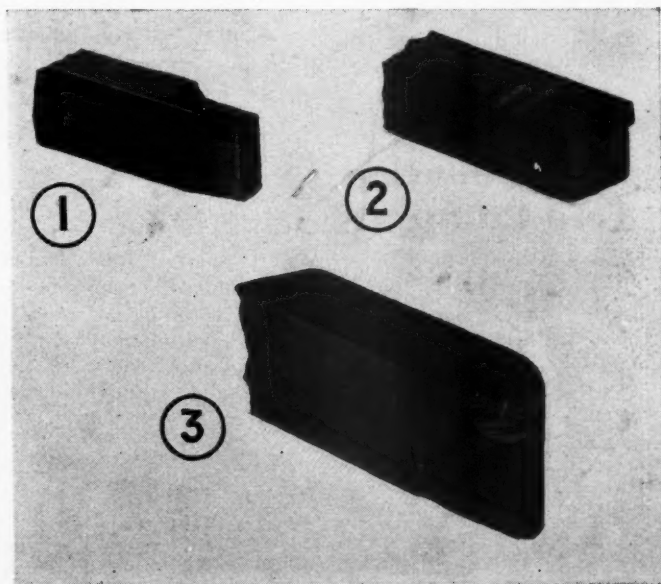
The Carboloy Company, Inc., Detroit, Mich., manufacturers of Carboloy cemented carbide tools and dies, recently completed a series of educational demonstrations in various cities showing an improved technique for grinding carbide tools.

This latest technique is of unusual interest to users of Carbide tools because of the drastic reduction in carbide tool grinding time made possible by following the recommended procedure.

Examples of the remarkably short periods now required to grind various types of carbide tools are shown in the accompanying illustrations. The tool, (size  $\frac{5}{8}$ -in. x  $1\frac{1}{4}$ -in.) shown at (1) in the illustration is typical of one dulled through ordinary use. It requires regrinding on the front and side clearances only. The average time required to completely resharpen a tool of this type, following the latest procedure, as shown at the demonstration, is between two and three minutes. The average time using previous methods would be from 20 to 40 min. A "milled and brazed" carbide tool

is shown at (2). "Milled and brazed" carbide tools are ones released by the manufacturer directly after the carbide tip has been brazed to the steel shank. Such tools require complete grinding on all surfaces at the cutting end of the tool, and ordinarily to grind a tool  $\frac{5}{8}$ -in. x  $1\frac{1}{4}$ -in., for example, would require from one to two hours. Under the new procedure, a tool this size can be completely conditioned in  $4\frac{1}{2}$  to 7 min. This greatly reduced grinding time is also found to be of benefit in the case of carbide tools chipped through accidental abuse. The tool shown at (3) is one of this kind (size  $\frac{1}{2}$ -in. x  $\frac{3}{4}$ -in.) chipped to a depth of about  $\frac{3}{16}$ -in. Frequently a tool in this condition might be considered a total loss and scrapped, due to the excessive amount of time required to recondition. Using the latest, improved technique it is stated that this tool can be completely reground in about 3 min.

The demonstrations of this latest procedure revealed several features which are important factors in making possible such drastic reductions in the time required for grinding carbide tools. These are: (1) The proper dressing of grinding wheels for rapid grinding. (2) the maintenance of constant motion of the tool while grind-



(1)—A dulled tool to be reground; (2)—A milled and brazed tool ready for grinding; (3)—A carbide tool chipped through accidental abuse.

ing. (3) the use of double or composite angles in the tools, and (4) alternate grinding on the carbide tip and steel shank when necessary to hog off large amounts of stock, as in the case of chipped carbide tools.

Regarding the first requirements—that of dressing the grinding wheels—the procedure followed for the roughing and semi-finishing operations on the face of a cup wheel, or on the periphery of a straight wheel was to shape a slight crown about  $\frac{1}{16}$ -in. high on the wheel. The area of contact is thus held at a minimum and excessive generation of heat thus avoided. The face of a cup wheel dressed flat, as usual, was recommended for finish grinding. The second factor—maintenance of constant tool motion—involved the steady motion of the tool across the surface of the wheel, and also the use of a rocking, or tilting, motion of the tool from side to side while roughing and semi-finishing. This avoids excessive grinding at any one spot on the tool and provides further means of avoiding excessive heat—an important factor if rapid grinding of carbides is to be successfully accomplished.

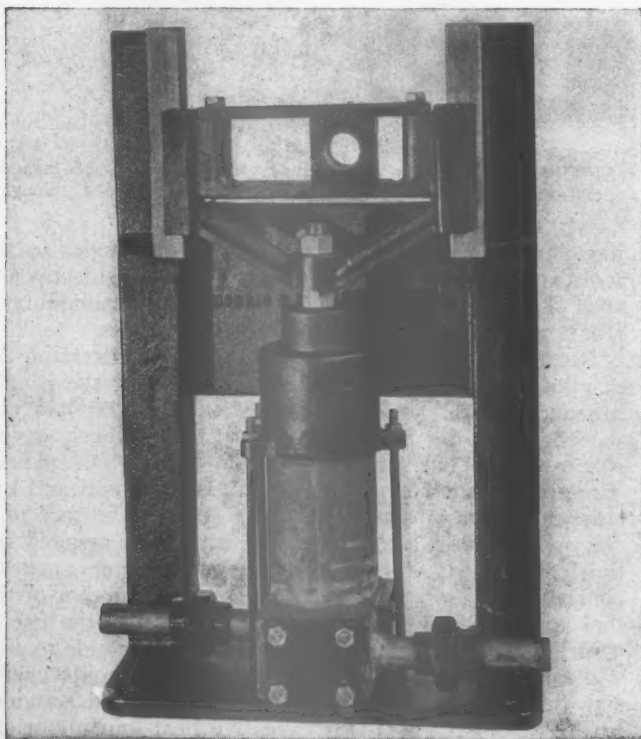
The third requirement—the use of double, or com-

posite clearance angles on the tool—was another feature of importance brought out. When rough grinding, the use of an angle 4 deg. greater than the finished angle desired was recommended. Finish grinding is then completed at the desired angle, grinding on the carbide tip only. By following this procedure no finish grinding on the steel shank is required, and the wheel remains open and free cutting for longer periods. This permits more rapid grinding and tends to produce a better finish.

The fourth requirement which was demonstrated is recommended for use when it is necessary to hog off large amounts of stock rapidly. The procedure outlined involves alternate grinding first on the steel shank, then on the carbide tip, continuing in this manner until the desired amount of stock is removed. Steel naturally loads silicon carbide wheels (made specifically for grinding carbides) more rapidly than ordinary wheels, whereas carbide tips tend to dress the wheels. By alternating first on the steel shanks and then on the carbide tip, more rapid grinding is possible. Of course ordinary aluminous oxide wheels can be used to grind on the steel shank when desired. However, in such cases, care must be used to avoid contacting the carbide tip. There are naturally other factors involved other than the four described above, such as use of proper wheels, correct machines, fixtures, etc. However, these four factors described above constitute the important features of the rapid technique demonstrated.

## Reciprocating Acid Pump

A reciprocating acid pump recently placed on the market by the Morris B. Brewster Company, Chicago, is designed for circulating a solution of commercial muriatic acid through the closed-type of locomotive feedwater heater for removing the incrusting and heat insulating solid deposits on the heating surface from the boiler feedwater.



Close-up view of Brewster acid pump used in cleaning closed-type feedwater heaters

This pump is sturdy in construction and is said to have proved its durability in heavy duty service. At 100 2-in. strokes a minute, it is designed to circulate about 750 gal. of acid solution through the feedwater heater an hour, which is the average time required for thoroughly cleaning a heater.

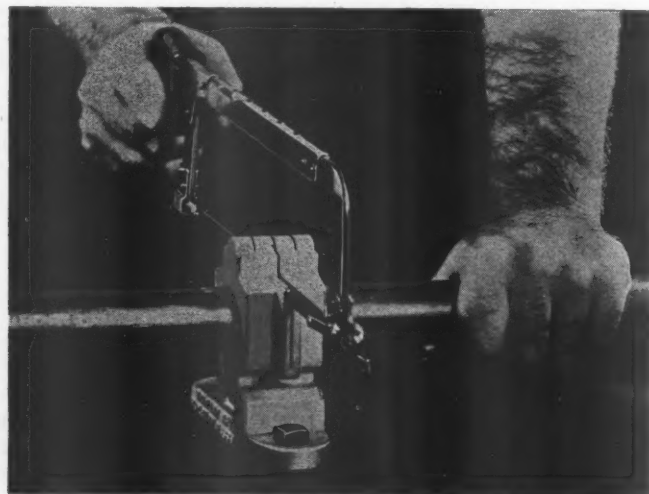
The pump is either electric- or air-motor driven and is constructed with acid resisting parts, such as a lead cylinder, hard rubber plungers and hard rubber check valves, with all other parts in contact with the acid being lead-protected and mounted on a suitable cast iron frame.

The entire assembly may be mounted, at the will of the purchaser, on a portable truck, which would carry with it the acid container from which the pump receives its supply of acid solution.

## Sawing Vise Set

The Trimont Manufacturing Company, Roxbury, Mass., has developed a tool for holding, sizing and cutting thin wall copper and brass tubing by the use of which absolutely square cuts are obtained, thus insuring a perfect bearing of the tubing against the fitting shoulder. There is no chance for an imperfect wavy cut due to play in the saw because the saw blade is held closely in guides which bear against and all around the tubing while the cut is being made.

The tubing is sized and held to round while being cut in this sawing vise, making it easy to slip on the fittings; the tubing cannot be forced out of round no



Trimont sawing vise set for copper and brass tubing

matter how much pressure is put on the vise. An additional advantage is that when a piece of tubing has been forced out of line slightly so that it will not enter the fitting, the Trimont vise will bring it back to round sufficiently for the fitting to be slipped on. This means a saving of tubing which might otherwise have to be thrown away. There is also saving of material, due to the fact that both ends of the tubing are held from sagging and prevented from forming break-off burr or flat lip at the completion of a cut.

The Trimont sawing vise set is made in units of from  $\frac{3}{8}$  in. to 2 in. and is serviceable for welding, brazing or sweat-fitting jobs.

# With the Car Foremen and Inspectors

## Finding the Average Life Of Freight Car Wheels

By F. R. Dorner\*

Car and locomotive wheels represent an investment by railroads and private car companies in the United States of well over \$200,000,000. The cost of maintaining this investment is a very important item of annual expense. Purchases of wheels, axles and tires by Class I railroads in 1935 amounted to \$17,489,000, which, although below normal, represented the largest item of iron and steel purchased except rails. Moreover, this is only a part of the maintenance expense. The additional labor cost for mounting, dismantling, turning, etc., would be appreciable.

More than ever, owners of equipment are seeking ways and means of reducing wheel expense, and ultimately improving their operating ratio. They are especially interested in wheels under freight equipment where, due to the large number, the opportunity for savings is greatest.

Two factors determine wheel expense: one, prices; the other, service or life. Prices are easily secured. Records of service life on the other hand, are more difficult to obtain. Both must be available. There is no economy in a low-priced article which does not last. Neither is there economy in buying a higher priced article which does not last long enough to be worth its extra cost.

The difficulty in obtaining a dependable and accurate value for wheel life under freight equipment is due to the following:

- 1—A lack of understanding of how wheels wear out or fail.
- 2—Incomplete records of wheel applications, removals and mileages.

It is the purpose of this article to discuss these two factors in detail, and to propose a method of measuring wheel life which is dependable and accurate.

Individuals do not all live the same length of time. Some die in childhood, others die in old age. It is also true that in a group all of the same age, the number which die each year is not the same. In other words, in a group of 1,000 people about 200 would die before they reached ten years, but only 100 would die between the ages of 20 and 40. About 300 would die between the ages of 50 and 70. Insurance companies, of course, know quite accurately how many will die each year. They have available a table of experience covering the lives of people which, when plotted, is called a mortality curve. It is the fundamental basis of their insurance costs.

A mortality curve on which to base costs might be drawn for practically any physical structure. Two typical curves for freight-car wheels are shown in the accompanying chart. These curves will tell how the wheels wear out or fail. Along the vertical axis is shown the percentage of the original units installed, which are still in service. The horizontal axis shows the age, or mile-

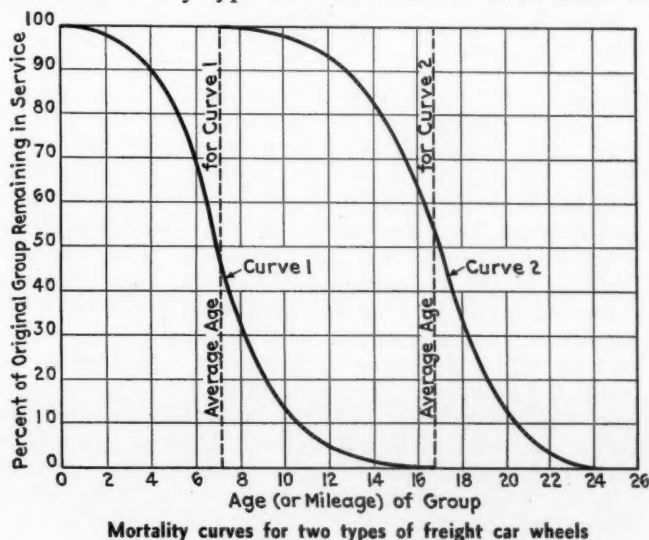
age. Any point on the curve, therefore, expresses the percentage of the original units still in service after a certain number of years or miles.

Curve 1 is for a type of wheel which starts to fail at an early age. The rate of failure gradually increases and then becomes more or less constant along the straight part of the curve. In later years the rate becomes less and a few wheels last a very long time.

Curve 2 is for a type of wheel which is in service for some years before it begins to fail or wear out. Then it follows more or less the same shape as Curve 1 with a few wheels lasting many years.

All railroad men having to do with wheels will recognize these facts. They have seen wheels removed after only a very short period of service and they have also seen wheels which have shown an unusually long life. It is often a temptation to draw conclusions from either group, which are of interest but tell little about average life.

The average life is, of course, the figure on which the value of any type of wheel must be calculated. It



is marked in the chart by vertical lines. If all the wheels reached the average age indicated and then were removed at one time the total mileage would be the same as the sum of the actual mileage for wheels removed according to the curve.

Recognizing the varying life of wheels, the only general and dependable method of finding average age or service is by establishing a mortality curve. Other methods have been used but are accurate only under specific conditions. Two of these will be presented.

Average age has been measured by dividing the number of wheels in service by the number replaced yearly. In the first place, purchases of wheels are often used instead of replacements. Thus, wheels replaced in interchange or removed from dismantled equipment are not included and the average life value may be high. Also, the wheels may not have been in use and the purchases for replacement may have been lower than normal. But the most important reason why this method is open to

\* Armco Railroad Sales Co.

criticism is that it does not give an accurate value unless the wheels have been in service at least for their average life and in some cases at least two or three times their average life. In other words, if this method were used for wheels at a time when they were just beginning to wear out, the value for average life would be much too high. Another criticism is that the value would be correct only when applied to a group of wheels originally installed at the same time.

A second method for finding average life is based on measuring tread wear after a definite mileage but this method cannot be used for all types of wheels. What is desired is the actual but not the theoretical mileage to be received from the wheel. Unless it can be established that all wheels actually wear out, the method is valueless. Some wheels are replaced due to defects before having worn to the condemning limit. When using this method it is necessary to project the experience obtained over a short period into the future. This, if carried too far, is unsound.

If the mortality method is the only dependable one to use, how can the curve be found?

The simplest way to establish a mortality curve is to choose a test lot of a 100 wheels or more which are subjected to average service conditions.

If two types of wheels are to be tested, one type should be used in one truck of the car and the other type in the other truck. This eliminates any possibility of different service conditions. Preferably the equipment should be in a service where the wheels can be watched closely and the mileage determined with some degree of accuracy. On such a test lot a record should be made for each wheel removed of the mileage or length of time in service and the reason for removal.

This test might have to run a number of years in certain cases before all the wheels were removed. However, earlier approximations of average life can be made. By knowing the general shape of the mortality curve, an average life value might be obtained after 20 per cent of the wheels had been removed. Also, the total mileage or age when around half of the wheels had been removed would be close to the average life. For a type of wheel practically all of which eventually wear out and are not replaced because of defects, it is possible to estimate the remainder of the mortality curve by measurements of wear. The mortality curve is drawn to cover the actual removals as far as the test has progressed and the remainder of the curve is computed based on the extent of the wear and how long the remaining wheels would be expected to last. This can often be used for wheels having a comparatively long average life.

Another method can be used for finding the mortality curve which requires that records be kept for only a year or two. Groups of at least 20 wheels, each group representing a different age are chosen for the test lot, and a record made of the removals over a period of a year. For example, on January 1, 1936, the test lot would consist of 20 or more wheels installed during 1935, a similar number installed in 1934, about the same number installed in 1933, and so on. Then until January 1, 1937 a record would be kept of each wheel that was removed and the reason why it was removed. If desired, the record could be kept for another year to check the results of the first year. From these records the rate of removal could be found and the mortality curve determined for a period equal to the age of the oldest wheels. In analyzing such test results, the mortality curve method is the only one which will show whether the wheels have been in service long enough to obtain a value for average life.

It is apparent from the methods just described for

finding the mortality curve that there are three essential facts that must be obtained from the records kept, that is

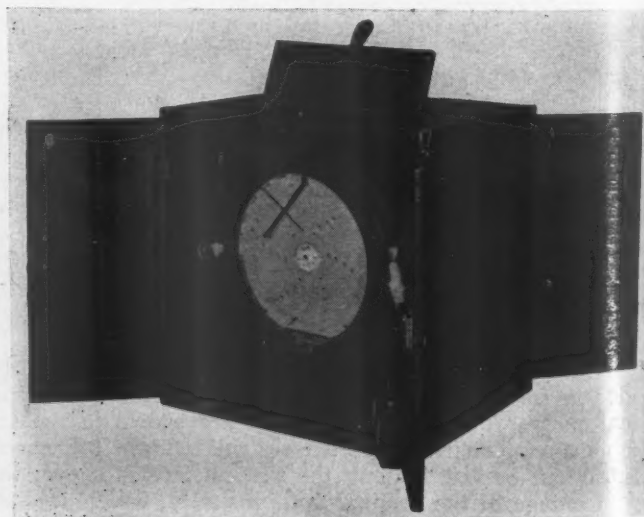
- 1—The mileage or time in service for every wheel removed.
- 2—The reason for removals.
- 3—The number of wheels which, after this mileage or time, still remain in service.

Generally speaking, unless the records show this information, they cannot be used for finding average life. For example, the mere fact that 50 wheels had been removed after five years means nothing, unless the reason for removal and number remaining in service or the number originally started with is known. The average life would be very different if in one case the original lot consisted of 100 wheels and in the other case consisted of 5,000 wheels. It is just as absurd to average the age of the first removals and call this the average life. In this case also, no consideration has been given to the cause of removal or to the number of wheels still remaining in service. The number of removals must always be considered with relation to the total number of wheels in service of the same age. The reason for removal will enable proper consideration to be given to withdrawals for causes not attributed to wheels, such as cut journals.

The large investment in wheels and the annual maintenance cost warrants more specific information on wheel life than is generally available. The application of the mortality curve presents a simple, accurate and dependable method for determining average life.

## Air-Conditioning Road And Laboratory Tests

To conserve an investment in air-conditioning equipment, estimated to have amounted to about forty million dollars since 1932, and to increase the effectiveness of future expenditures in this field, the Association of American Railroads has authorized an extensive study of air conditioning in passenger cars. This study is to be made under the direction of L. W. Wallace, director of equipment research of the A.A.R., and, as the first step, a manual outlining the purpose of the program and schedules of the study has been prepared. A comprehensive report is promised by November, at which time air-conditioning programs for 1937 will be under consideration.



Air-conditioning engineer's compact test kit as equipped with Brown temperature and humidity recorder

The principal objectives of the investigation, as summarized in the manual, are: (1) to determine the basic practices and policies which should be adopted with respect to air-conditioning railroad passenger cars; and (2) to determine what system or systems are most suitable for railway service as measured in terms of (a) capital investment, (b) cost of maintenance and operation, and (c) satisfaction and well being of passengers.

Involved in such determinations are design, performance and cost problems. To obtain basic and reliable information relating to these matters, two types of investigations are necessary; namely, road and laboratory. The work has been so planned that the results of the road and laboratory work supplement each other, thereby making it possible to secure an objective picture of existing conditions and what may be done to improve them.

It is essential that factual information be secured with reference to many aspects of the air-conditioning systems now being used by the railroads. These may be classified under three headings, namely: (A) Mechanical, design and performance; (B) investment, operating and maintenance costs; and (C) results obtained as regards temperature, humidity, distribution, quality, cleanliness of air, and odors.

In order to obtain the necessary information covered by (A) and (C), the following specific data is to be secured:

(1) Method of controlling temperature and humidity in cold and warm weather and with what results. This eventually will involve establishing a standard temperature and relative humidity relationship for various sections of the country and a temperature differential with respect to outside conditions.

(2) The type of air filters used and the results being obtained; the directions in which improvements may be made so as to secure more satisfactory results.

(3) The amount of power being used per unit of work done (which is power per ton of refrigeration).

(4) Means used in securing diffusion of air within the cars that are materially different from common practice.

(5) The difficulties, if any, in installing, operating and repairing the power plant for air-conditioning.

(6) The facilities for servicing equipment in the yards.

(7) The experience had with odors and what means have been adopted to lessen this problem and with what success.

(8) Difficulties experienced in making inspections and repairs.

(9) Time required to inspect, repair and replace the various units of the several air-conditioning systems.

(10) Determine actual results being obtained in air conditioned cars with respect to temperature, humidity, cleanliness, odors, air movement and distribution of air.

### Work Already in Progress

Through the courtesy of the Baltimore & Ohio, facilities have been made available at the Mt. Clare shops, Baltimore, Maryland, for making laboratory tests of each type of air conditioning being used on railroad passenger cars. Through the generous and interested co-operation of the manufacturers, their respective equipment is being sent to Baltimore for test. The test work began there March 15. To date six systems have been thoroughly tested. This phase of the work will be completed in August. The equipment is being tested in accordance with the standard method of rating and testing air-conditioning equipment, as prepared by the Joint Committee on Rating Commercial Refrigerating Equipment from the American Society of Refrigerating Engineers and the American Society of Heating and Ventilating Engineers.

The object of these tests is to compare the performance of each system as a whole and also that of each major element of the several systems: compressors, condensers and evaporators. The amount of power required per unit of cooling effect produced will be determined also. It is recognized that the amount of power consumed in the operation of an air conditioning system is of great importance. Therefore, the character and efficiency of the type of drive or prime mover is to receive careful study. For this purpose a special program for the testing of the several types of drives used is to be conducted at Ohio State University. This program started early in June and will be completed in August. By correlating the data secured in the tests of the com-

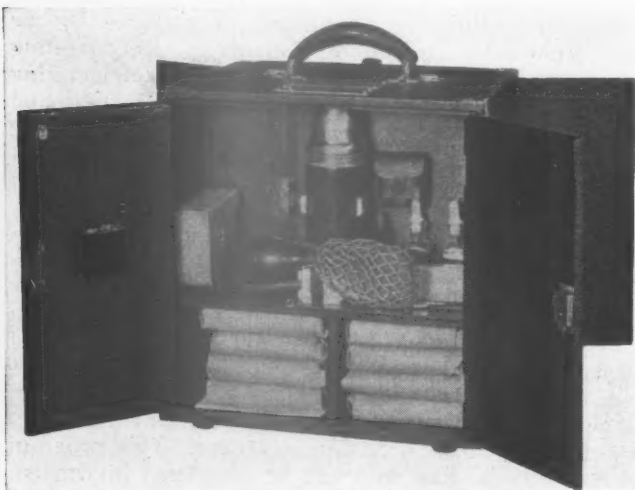


Railway air-conditioning engineers at five-day conference held at Ohio State University, Columbus, Ohio, July 6 to 10, inclusive

pressor, condenser and evaporator at Baltimore, the relationships between the cooling effect produced and the power delivered into the system will be determined.

The Pullman-Standard Car Manufacturing Company has provided facilities at Pullman for the testing of four cars at one time. About 15 cars have been tested. The test program comprehends hot-room tests of air-conditioned cars conducted for the purpose of determining the cooling load required when all factors of loading are present, as in road service, except those caused by solar radiation and wind effect. A second objective is the determination of the effectiveness of the insulation of the car. Further objectives (not previously stated) are a study of the air and temperature distribution within the car; the determination of the amounts of fresh and recirculated air supplied for various settings of the fresh-air damper; and the determination of the comparative temperatures occurring within the car when heated and humidified as it would be when occupied to full capacity.

These tests, completed in July, were made on the following types of cars, as operated by various railroads



Rear view of the opened test kit showing some of the auxiliary equipment used for various test purposes

and equipped with each type of air-conditioning system tested at Baltimore: coach, lounge, diner, combination, sleeper and cafe. The results of these tests will supplement those obtained at Baltimore.

#### Road Tests to Include Study of Public Reactions

During the latter part of July and August an extensive road testing program will be conducted simultaneously on railroads throughout the country in order to accumulate a large amount of data covering the performance and efficiency of the various systems in all kinds of cars and under all kinds of different operating conditions. Provision has been made, however, for taking temperature and other readings with identical equipment and in the same manner so that the results will be directly comparable.

For the purpose of outlining this program of tests, a five-day conference has just been concluded at Ohio State University, Columbus, Ohio, attended by 31 air-conditioning engineers representing the following railroads: Atchison, Topeka & Santa Fe, Atlantic Coast Line, Baltimore & Ohio, Boston & Maine, Maine Central, Canadian Pacific, Central of Georgia, Chicago & Eastern Illinois, Chesapeake & Ohio, Chicago & North Western, Chicago, Burlington & Quincy, Chicago, Milwaukee, St. Paul & Pacific, Chicago, Rock Island & Pacific, Delaware, Lackawanna & Western, Florida

East Coast, Great Northern, Illinois Central, Lehigh Valley, Louisville & Nashville, Missouri Pacific Lines, New York Central, New York, New Haven & Hartford, Northern Pacific, Pennsylvania, Reading, St. Louis-San Francisco, Seaboard Air Line, Southern Pacific and the Wabash.

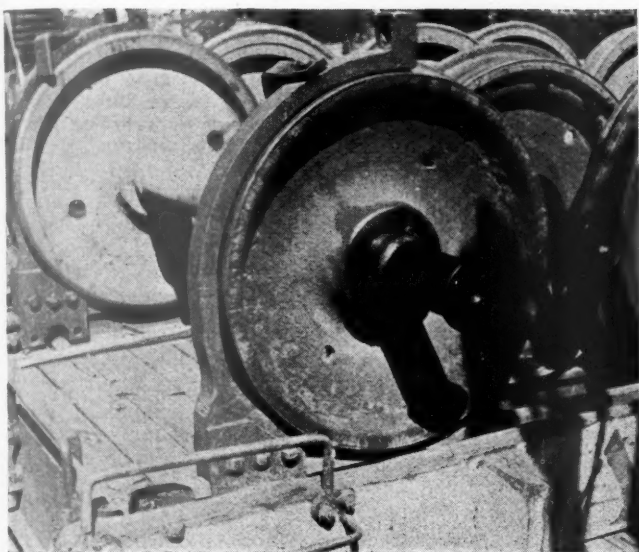
According to the program, about 400 air-conditioned and non-air-conditioned cars will be ridden for test purposes during the next few weeks. Each engineer will ride cars of different types in specified trains on his own line and be equipped with a kit of instruments for the purpose of making necessary measurements. As shown in the illustrations, this kit consists of the following equipment: Brown temperature and humidity recorder, Kata thermometer for examining air velocity, psychrometer for obtaining humidity, anemometer to determine fresh and recirculated air used, Wolpert's air tester to determine the amount of CO<sub>2</sub> in the air, culture plates to determine the bacteria colonies, thermometers to determine outside temperatures, stop watch and accessories, such as thermos bottles, steel measuring tape, pliers, etc.

In connection with these road tests, a questionnaire has been prepared which will be distributed to passengers by the research engineers. In that questionnaire, inquiry will be made as to whether, in the opinion of the passenger, the car or train is too warm or too cool; if it is "clammy," stuffy, drafty or noisy, or possibly too cool upon entering. Passengers will also be asked whether there are any objectionable odors, evidence of smoke when passing through tunnels, excessive tobacco smoke, and, if occupying a berth in a sleeping car, whether it is too warm or too cool or is sufficiently ventilated. If the air-conditioning is or is not entirely satisfactory the passenger is going to have an opportunity to express himself to such extent as he sees fit. These questionnaires will be collected by the research engineers and the answers carefully tabulated.

Every important phase of the air conditioning of passenger cars is covered in the program of road and laboratory tests which has been developed. As a consequence, the test results promise to be comprehensive and generally beneficial both to railroads and to manufacturers of air-conditioning equipment. It is felt that, with these test results available, railroads can proceed with their air-conditioning programs with much more assurance as to costs and as to the conditions actually obtained in passenger cars.

#### Loading Car Wheels For Shipment

The method illustrated provides a safe and quick method of loading car wheels on flat cars for shipments between the central wheel shop or stores department and various car repair points, or scrap disposal yards on a railroad. The method consists simply of spiking four rails to the floor of a flat car so spaced that the wheels will be "nested" in accordance with the usual manner. A forged steel clamp is bolted to each end of one pair of rails, this clamp providing a substantial wedge stop at the bottom of the wheel and having the upper part of the clamp forged in a segment to fit approximately 120 deg. of the wheel tread. This clamp is held on the tread of the wheel and against the flange by means of a swinging steel angle strap. The upper end of each clamp is forged to a substantial rectangular shape which can be drilled for the application of a 1-in. tie rod and double nut, this rod extending the length of the car so



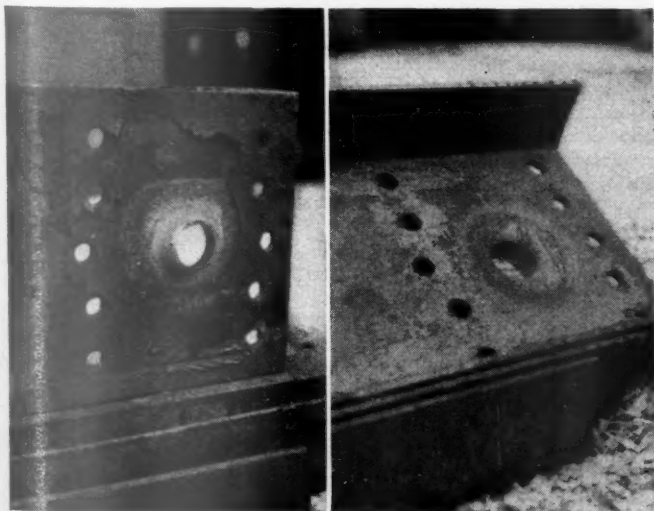
Safe and relatively inexpensive method of loading wheels on a flat car

that when tightened it holds the wheels rigidly against shifting. Experience has shown this method of loading car wheels to be cheaper and quicker than spiking wooden wedges to the floor to hold each pair of wheels.

## Reclaiming Spring Plank From Arch Bar Trucks

Because of the outlawing of arch bar type freight car trucks after January 1, 1938 most of the railroads have arranged to remove them from cars on a monthly schedule which provides for the application of cast steel side truck frames to all such cars which are to be used in interchange service after that date.

To reduce the cost of this project it is desirable to make use of as many parts from the arch bar trucks as possible. Truck bolsters, both cast steel, Simplex and other built-up types are interchangeable and the brake beams, brake hangers, brake levers, pins, etc., can be reclaimed and used on the cast steel side frame truck. However some difficulty has been experienced in reclaiming 13-in. spring plank channels due to the lack of facilities for riveting or otherwise securing the channel



These two views show both sides of the channel after punching

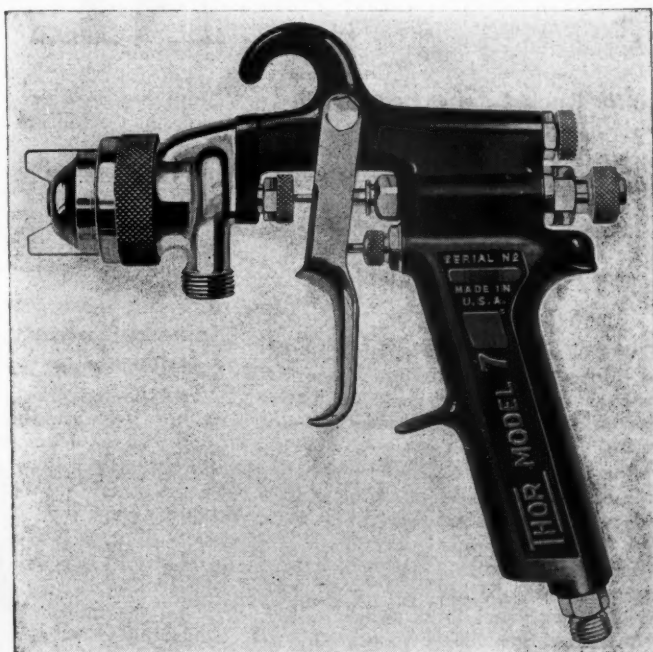
type spring plank to the cast steel truck sides having the journal boxes cast integral.

The two illustrations will show the method employed by one railroad in reclaiming the spring plank channels. A one-inch hole is punched in the center of the spring plank channel and the surface for a distance of five inches around the hole is heated. A set of dies, which can either be attached to a steam hammer or to some pneumatic device are used to punch through the heated area on the top surface of the channel which will provide a one-inch lip on the base. This will permit the lip of the opening to set down in the base of the cast steel truck frame, and when the truck springs and bolster is applied no other provision for securing the channel to the truck side is necessary.

## Production Spray Gun

Great speed, low air consumption and perfect atomization are claimed for the new Thor Model 7 spray gun made by the Binks Manufacturing Company, 3114 Carroll avenue, Chicago.

The Thor Model 7 gun has incorporated in it a number of good points suggested by users of the spray painting process. The gun body is of durable drop-



Thor Model 7 paint spray gun

forged aluminum with a black electrolytic coating for surface protection. The air nozzle is of drop-forged bronze, chromium plated. The material nozzle and the nozzle valve are of stainless steel, hardened and polished. The adjustments are ample and well located. The fluid connection is of  $\frac{3}{8}$ -in. pipe size and the air connection  $\frac{1}{4}$ -in. pipe.

**STREAMLINED NICKNAMES**—It was inevitable that the railroaders with their genius for nicknames should rechristen some of the new fast trains. The "Zephyr" has become the "Zipper" and, along the Milwaukee, the "Hiawatha" is known as the "Highwater."



Illinois Central 1,800-hp. Ingersoll-Rand-General Electric Diesel-electric locomotive for switching and transfer service

# NEWS

## Fire at Rock Island Enginehouse

THE enginehouse of the Chicago, Rock Island & Pacific, at St. Joseph, Ill., was damaged by fire on July 5 to an estimated extent of \$200,000, including damage to three locomotives and the machine shops.

## U.P. Creates Department of Research

THE Union Pacific has established a bureau of research, with O. Jabelmann, assistant general superintendent of motive power and machinery, with headquarters at Omaha, Neb., as its head. Men now engaged in research work have been assigned to the new bureau, and mechanical, electrical and metallurgical experts will be added. The bureau will study, survey and perfect improvements in design and construction of cars and locomotives.

A photograph and brief sketch of Mr. Jabelmann's career appear on page 373 of this issue.

## S. W. Dudley Nominated Manager of A.S.M.E.

S. W. DUDLEY, recently appointed dean of the Yale School of Engineering, Yale University, New Haven, Conn., is among the A.S.M.E. nominees for the year 1937. Dean Dudley, together with E. W. Burbank, manager, Allis Chalmers Mfg. Co., Dallas, Tex., and Kenneth H. Condit, editor, American Machinist, New York, has been nominated to serve as a manager of the Society. The presidential nominee is James H. Herron, president of the James H. Herron Company, Cleveland, Ohio, and those for vice presidents are J. A. Hall, professor mechanical engineering, Brown

University, Providence, R. I.; J. M. Todd, consulting engineer, New Orleans, La.; R. J. S. Pigott, staff engineer, in charge of engineering, Gulf Research & Development Corporation, Pittsburgh, Pa.

At the semi-annual meeting held at Dallas, Tex., June 15-20, it was also voted to hold the 1937 semi-annual meeting at Detroit, Mich.

## Eastern Committee Appointed to Continue Co-ordination Studies

THE Eastern Presidents' Conference at its July 16 meeting appointed a committee to take up the unfinished work of the Eastern Regional Co-ordinating Committee in connection with co-ordination projects concerning which no definite action had been taken at the expiration of Interstate Commerce Commissioner Eastman's term as federal co-ordinator of transportation.

The appointment of this committee, the announcement says, is in accordance with a request of the Association of American Railroads, which asked Eastern, Western and Southern regional organizations to arrange for carrying forward studies which had been considered by the regional co-ordinating committees on behalf of the federal co-ordinator, as well as "such other projects as might from time to time be presented, having in view economies in operation through co-ordination of services of facilities."

## Public Asked to Express Views on Air-Conditioning

THE traveling public for the next few months is to be asked to submit its views on the efficiency of the air-conditioning equipment now in use on passenger trains

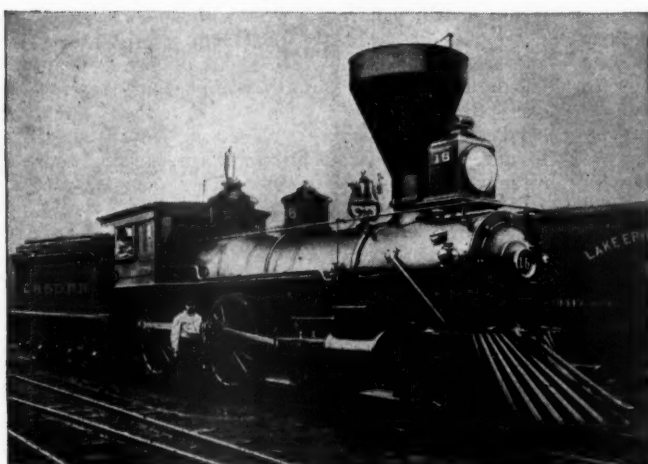
throughout this country, J. J. Pelley, president of the Association of American Railroads, has announced.

This is to be done in connection with the exhaustive research now being conducted by the Equipment Research Division of the Association of American Railroads in order to determine how well the various air-conditioning devices in use on passenger cars function under varying climatic and operating conditions, what might be done to improve their performance, and what standardization of such equipment can be developed in order to reduce costs of operation and maintenance.

Air conditioning engineers from 30 of the leading railroads have for the past few weeks been engaged in an intensive study of that subject at Ohio State University and elsewhere and, beginning this week, they will conduct a series of tests on trains throughout the United States in order to secure data as to the results being obtained from air conditioning of passenger cars.

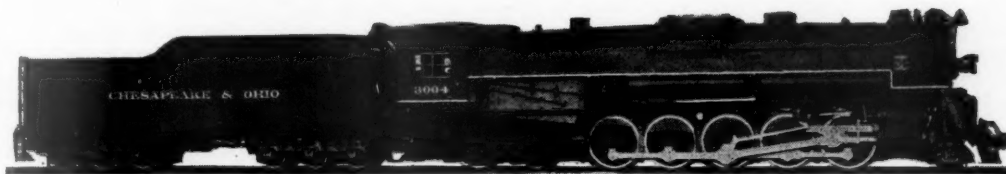
In connection with those tests, there has been prepared a questionnaire which will be distributed to passengers by the research engineers. In that questionnaire, inquiry will be made as to whether, in the opinion of the passenger, the car or train is too warm or too cool; if it is "clammy," stuffy, drafty or noisy, or possibly too cool upon entering. Passengers will also be asked whether there are any objectionable odors, evidence of smoke when passing through the tunnels, excessive tobacco smoke, and, if occupying a berth in a sleeping car, whether it is too warm or too cool or is sufficiently ventilated. These questionnaires will be col-

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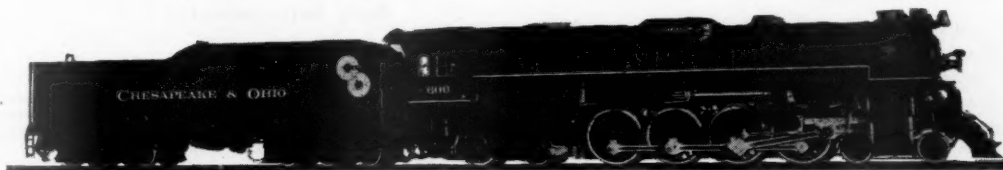


## MOTIVE POWER DEVELOPMENT on the C. & O.

Just one generation ago wood burning 4-4-0 type locomotives like that shown above were hauling thru fast trains over lines now part of the C. & O. At that time this power was the foremost of locomotive developments.



Continuously maintaining its position among the leaders in locomotive progress the C. & O. in 1930 placed in service the large freight power shown above.



The latest additions to its modern equipment are the Greenbrier Type locomotives which the C. & O. placed in service in January of this year. In results obtained in improved operating efficiency and economy, this new power reflects the ability and progressive foresight of the management.

LIMA LOCOMOTIVE WORKS



INCORPORATED, LIMA, OHIO

lected by the research engineers and the answers carefully tabulated. At the same time the answers will be compared with the analysis of air-conditions shown to have existed through scientific tests in that particular car or train on that day.

In order to make these tests, the research engineers have been equipped with small, especially designed kits about the size of an ordinary handbag, containing the most delicate and sensitive instruments that have yet been devised for this purpose. These instruments, among other things, will record and measure the slightest draft, one which can not be felt by the ordinary person; chart the humidity and temperature as they may vary in the car over a 24-hour period; detect the remotest trace of carbon dioxide in the car as well as count the bacteria in the air. Another will calculate the actual refrigeration, while still another will show the effect of the rays of the sun through the windows and against the curtains of the car.

The course of special study which these research engineers have been undergoing at Ohio State University has covered all phases of air-conditioning. It has been conducted by L. W. Wallace, Director of the Equipment Research of the Association of American Railroads, and by Professor A. I. Brown, of the Engineering School of that University, who is serving as a special consultant in this matter.

At the same time these road tests are being made a series of experiments by the Research Equipment Division as to air conditioning of passenger cars will be under way at Ohio State University, the Mt. Clare Shops of the Baltimore & Ohio, at Baltimore, and the Pullman-Standard Car & Manufacturing plant in Chicago. In those experiments, various types of air conditioning equipment will be put through exhaustive tests in order to ascertain what improvements can be made so as to insure the maintenance of proper temperatures under varying climatic conditions in passenger cars.

### Railroads Ask I.C.C. to Dismiss Power Reverse Gear Case

SAFETY to employees and the public would not be increased by compelling the railroads to install power reverse gear on virtually all locomotives, and the only result would be to place a heavier financial burden on the rail carriers at a time when they can least afford it, according to a brief filed by the Association of American Railroads asking the Interstate Commerce Commission to dismiss proceedings brought by the Brotherhood of Locomotive Engineers, and the Brotherhood of Locomotive Firemen and Enginemen to require the installation of power reverse gears as a substitute for hand operated gears.

Such an order, if promulgated by the commission, would require the installation of power reverse gears on more than 18,000 locomotives at a cost in excess of \$7,000,000, according to the brief. Replying to contentions of the complainants that power reverse gears would bring about increased safety in the operation of locomotives, the brief said:

"Accidents to men in the locomotive cab involving movements of the lever are more

common with hand gears than with power gears but such accidents are seldom severe and are, with negligible exceptions, if any, not the result of any fault or quality which can be remedied only by elimination of the hand gear. On the other hand, accidents to men working around locomotives, due to movements of the reverse gears, and accidents due to locomotives running into roundhouse walls and turntable pits, are more common with locomotives equipped with power gears. These accidents are often serious and are largely due to characteristics inherent in the power gear, that is: to the relatively great force which impels the moving parts of the gear; to the unexpected movements of the gear or engine caused by 'creeping' or 'settling' as a result of which the position of the lever in the cab does not correspond with the position of the valve gear; to the inability of the operator of the lever to feel an obstruction in the event a man is caught in the moving parts of the gear; to the inability to stop promptly the movement of the gear by operating the lever in the cab; and to the fact that a power reverse gear cannot be utilized as a braking device in the absence of suitable air pressure. None of these faults or disabilities is encountered with hand gears.

"Virtually all railroad expenditures have a direct bearing upon safety," the brief continued. "Every feature of railroad operation is related to safety and over-emphasis on one feature, with the resulting under-emphasis on others, is bound to affect adversely, rather than to promote, the safety of railroad operation as a whole. Thus, the installation of power gears should not be required unless the commission should find that it would serve an unmistakable and important purpose in promoting safety. The record furnishes no possible basis for such a finding. On the contrary, it clearly shows that considerations of safety are not involved."

This is the second time that this matter has been considered by the Interstate Com-

merce Commission. In 1930 the organizations of locomotive engineers and firemen instituted proceedings to have power reverse gears installed on all steam locomotives on the ground that the manually operated gears constituted an unnecessary peril to life and limb. The commission issued an order requiring this to be done, but a three-judge federal district court in Cleveland enjoined the commission from enforcing the order on the ground that it was arbitrary and that the commission had failed to consider fairly all of the pertinent and substantial facts. The United States Supreme Court affirmed the order of the lower court. In March, 1935, the engineers and firemen petitioned the commission to reopen the proceedings and to have further hearings. This petition was granted and the commission recently concluded hearings in the case.

### Historical Society Trip Marks Morris & Essex Centennial

A CAMEL-back ten-wheeler built in 1910 returned temporarily to main-line service on the Delaware, Lackawanna & Western on Sunday, July 19, when it drew a special train containing a party organized by the New York Chapter of the Railway and Locomotive Historical Society from Hoboken, N. J., to Scranton, Pa. The trip marked the centennial of the Morris & Essex, now the route of the Lackawanna across New Jersey.

The locomotive was resplendent with new paint and burnished fittings and it further belied its age by pulling the train up a slight grade of 28 mi. in 26 min., according to the timing of the historians. It was equipped with the Wooten wide firebox designed for anthracite and had separate cabs for the engineman and fireman. It was built at the Schenectady works of the American Locomotive Company.

The combination baggage car used was about the same age as the locomotive but the following dining car and three coaches were the latest air-conditioned types.

(Continued on next left-hand page)

### New Equipment

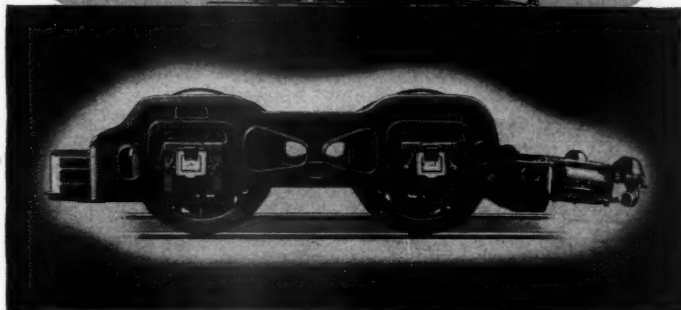
LOCOMOTIVE ORDERS			
Road	No. of locomotives	Type of locomotive	Builder
P. & W. V.....	2	2-6-6-4	Baldwin Locomotive Works
R. F. & P.....	5	4-8-4	Baldwin Locomotive Works
Union Pacific .....	1	3,600-hp. Diesel-elec.	Electro-Motive Corp.
LOCOMOTIVE INQUIRIES			
Monessen Southwestern .....	1	0-6-0	.....
FREIGHT CAR ORDERS			
Road	No. of cars	Type of car	Builder
A. T. & S. F.....	10	Covered hopper	American Car & Foundry Co.
Aluminum Ore Co.....	50	70-ton covered hopper	Pullman-Standard Car Mfg. Co.
American Refrigerator Transit Co.	510	40-ton refrigerator	American Car & Foundry Co.
	510	40-ton refrigerator	General American Trans. Co.
Cambria & Indiana.....	300	50-ton hopper	American Car & Foundry Co.
Central of Georgia.....	200*	Hopper	Pullman-Standard Car Mfg. Co.
Minneapolis & St. Louis.....	60	Gondola	General American Trans. Co.
M. St. P. & S. S. M.....	500	Box	Pullman-Standard Car Mfg. Co.
Newfoundland Ry.....	50†	30-ton box	Koppell Indus. Car & Equip. Co.
Norfolk & Western.....	800	40-ft. box	Ralston Steel Car Co.
	100	Auto., with loaders	Magor Car Corp.
	100	50-ft. box	Greenville Steel Car Co.
St. Louis Southwestern.....	50	Automobile	General American Trans. Co.
Wisconsin Central .....	250*	Box	Pullman-Standard Car Mfg. Co.
Western Maryland .....	25	Caboose	Company shops
FREIGHT-CAR INQUIRIES			
Kennecott Copper Corp.....	50	100-ton ore	.....
Lehigh & New England.....	6	Caboose	.....
PASSENGER-CAR ORDERS			
Seaboard Air Line.....	6	Coaches	Pullman-Standard Car Mfg. Co.
	4	Comb. pass-bagg.	Pullman-Standard Car Mfg. Co.
T. & N. O.....	5‡	First-class coaches	National Steel Car Corp., Ltd.
	4	Comb. bagg.-coach	National Steel Car Corp., Ltd.

\* Subject to approval by the Court.

† 42-in. gage.

‡ To be air-conditioned.

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## FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK

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# Supply Trade Notes

THE R AND C COMPANY, 1218 Olive street, St. Louis, Mo., has been appointed to represent in that region the Graham-White Sander Corporation, Roanoke, Va.

L. K. SILLCOX, vice-president of the New York Air Brake Company, has been appointed first vice-president, and K. E. Keiling, assistant to president, has been appointed vice-president and sales manager.

THE STANDARD STOKER COMPANY, INC., has reorganized its engineering staff with headquarters at Erie, Pa., as follows: C. R. Davison is now mechanical engineer and E. F. Seibel is chief draftsman. This department was formerly headed by the late H. P. Anderson, chief engineer.

THE GLOBE STEEL TUBES CO., Milwaukee, Wis., has opened a new sales office at 1478 Starks building, Louisville, Ky., in charge of W. H. Buley, former sales supervisor at Milwaukee. C. J. Bickler, sales engineer at Milwaukee, has been appointed manager of sales of the Cleveland district, with office in the Terminal Tower building, Cleveland, Ohio. C. D. Haven, formerly connected with the Chicago office, is associated with Mr. Bickler.

WALLACE W. SMITH, assistant to the vice-president in charge of sales of shapes, plates and steel piling, of the Inland Steel Company, Chicago, has been promoted to assistant vice-president in charge of the sale of structural shapes, plates, floor plates and steel sheet piling, and Maurice E. O'Brien, sales representative, has been promoted to manager of sales, carbon steel bars and billets, and will also have charge of sales to manufacturers of agricultural implements.

E. I. HETSCH, formerly assistant to chief mechanical engineer of the Nathan Manufacturing Company, has been appointed sales engineer of the Q & C Company, with headquarters at 90 West street, New York. Mr. Hetsch was educated at John Hopkins University and is a graduate of the Institute of Machine Design at Karlsruhe, Germany. He entered railroad service in 1920 with the Chesapeake & Ohio and after serving in various capacities was assigned to special work in a study of locomotive lubrication.

PAUL C. CADY, formerly of the engineering department of the New York Central, has been elected vice-president in charge of sales for the Eastern district for the Union Railway Equipment Company, Chicago, with headquarters at 30 Church street, New York, and B. C. Tucker, formerly of the Midland Railway Supply Company, has been appointed sales representative in charge of special work, with headquarters in the Midland Building, Cleveland, Ohio.

THE COLORADO FUEL & IRON CORPORATION, a newly formed organization, has taken over the assets of the Colorado Fuel & Iron Company, under a court order of

Federal Judge J. Foster Symes. The Colorado Fuel & Iron Company had been in the hands of a receiver and trustee since August, 1933, the approval of its reorganization plan was confirmed by formal court order on April 26. The officers of the new corporation are: Arthur Roeder, president; S. G. Pierson, vice-president and treasurer; W. A. Maxwell, Jr., N. H. Orr, and Thomas Aurelius, vice-presidents; D. C. McGrew, secretary; H. C. Crout, assistant treasurer; Harry P. Fish, assistant secretary; Terrell C. Drinkwater, assistant secretary; Fred Farrar, general counsel; W. B. Montgomery, controller; and J. A. Bullington, assistant controller.

F. H. HARDIN, assistant to the president of the New York Central, has resigned to accept the position of president of the Association of Manufacturers of Chilled Car Wheels on September 1. He will succeed J. A. Kilpatrick, who will devote his time to private interests.

THE MILCOR STEEL COMPANY, Milwaukee, Wis., has been consolidated with The Inland Steel Company, Chicago, effective July 1, following the purchase of all of the outstanding stock of the Milcor Company for 59,000 shares of the capital stock of Inland. No changes will be made in the management or operations of the Milcor Company. The present officers will continue to operate the company as a unit. The Milcor Company, manufacturers of sheet metal building products, has plants at Milwaukee and Canton, Ohio, and warehouses at Chicago, Kansas City, Mo., and LaCrosse, Wis.

## Obituary

GEORGE SYKES, assistant to the president of the Baldwin Locomotive Works, died in Media (Pa.) Hospital on July 10, from injuries received the previous day when he was thrown from the back of his horse. Mr. Sykes was born in Yorkshire, England, and was 48 years old at the time of his death.

CLAYTON MARK, president of Clayton Mark and Company, Chicago, and a director of the National Malleable and Steel Castings Company, and the Interlake Iron Company, died in Lake Forest, Ill., on July 7 after a month's illness. Mr. Mark was born in Fredericksburg, Pa., in June, 1858, and in 1876 entered the employ of the Chicago Malleable Iron Company as a clerk. When this company was succeeded by the National Malleable and Steel Castings Company he continued in its employ, being a director until 1894, a second vice-president until 1902, and a resident vice-president until 1917. In 1902 he organized the Mark Manufacturing Company, of which he was president until 1919, when the company was merged into the Steel and Tube Company of America, of which

he became chairman of the board. He retained the latter position until this company was sold to the Youngstown Sheet and Tube Company in 1923, at which time he organized Clayton Mark and Company, of which he was president at the time of his death.

JOHN GILMORE PLATT, president of the Hunt-Spiller Manufacturing Corporation, Boston, Mass., was drowned Sunday, July 26, in Long Pond, near his summer home at East Harwich on Cape Cod, his motor boat being capsized by the wind. Mrs. Platt and their daughter, Mary, were rescued.

Mr. Platt joined the Hunt-Spiller Manufacturing Corporation in 1907 as mechanical representative. He was made sales manager in 1912, was elected vice-president in 1917, and has been president of the corporation since 1928. He was born in Zanesville, Ohio, February 11, 1874, and attended the public schools of Baltimore, Md. He entered the service of the Baltimore & Ohio in 1889 as a messenger, and a year later became an apprentice in the locomotive department. In 1894 he was made a locomotive draftsman and in 1901 became chief draftsman at Newark, Ohio. He went with the Erie Railroad at Jersey City, N. J., in 1902, as assistant to



John G. Platt

the master mechanic, and in 1903 was transferred to Meadville, Pa., as engineer of tests. In 1907 he left railroad service and became master mechanic of the Franklin Branch of the American Steel Foundries, leaving that position in the same year to go with the Hunt-Spiller Manufacturing Corporation.

Mr. Platt always took a keen interest in the Railway Supply Manufacturers' Association and was a member of its executive committee from 1916 to 1920, and chairman of its exhibit committee in 1920. He has also been a member of the governing board of the Railway Business Association, and a member of the finance committee of the New England Railroad Club. He was a director of the Brighton Savings Bank and a member of the Engineers Club of Boston.

## Personal Mention

### General

**F. H. HARDIN**, assistant to the president of the New York Central, has resigned to accept the position of president of the Association of Manufacturers of Chilled Car Wheels on September 1.

**J. F. LEIGHTIZER**, master mechanic of the Island Division of the Canadian National, has been appointed assistant superintendent and master mechanic, Island Division, with headquarters at Charlottetown, P.E.I.

**L. D. RICHARDS**, superintendent of motive power of the Chicago, Rock Island & Pacific at Kansas City, Mo., has been appointed district superintendent of motive power, with jurisdiction in mechanical matters and with headquarters at El Reno, Okla.

**PHILIP J. NORTON**, district superintendent of motive power and machinery of the Union Pacific at Pocatello, Idaho, has been appointed assistant general superintendent of motive power and machinery, with jurisdiction over the locomotive and car departments of the Central, Northwestern and Southwestern districts, with headquarters at Pocatello. The promotion is coincident with the assignment of Otto Jabelmann to head the Union Pacific's new research bureau.

**STANLEY M. HOUSTON**, superintendent of motive power of the Southern Pacific of Mexico at Empalme, Son., Mexico, has been appointed assistant general manager of the Southern Pacific of Mexico, with headquarters at Guadalajara. Mr. Hous-



Stanley M. Houston

ton was born on June 5, 1898, at Albuquerque, N. M., and entered railway service on March 30, 1913, as a machinist apprentice with the Arizona Eastern at Globe, Ariz. On April 1, 1917, he was promoted to machinist, and on March 1, 1919, to roundhouse foreman. From March, 1922, to March, 1923, he was general foreman, and from the latter date to October, 1924, master mechanic. In October, 1924, he resigned to become superintendent of shops of the Southern Pacific of Mexico, which position he held until July, 1927, when he became superintendent of motive power.

**OTTO JABELMANN**, assistant general superintendent of motive power and machinery of the Union Pacific, with headquarters at Omaha, Neb., who heads the newly-established research bureau of this company, was born in Cheyenne, Wyo., and



Otto Jabelmann

started service with the Union Pacific in 1906 at the age of 16 as a caller in the enginehouse at that point. He has been continuously in the service of the Union Pacific since that time, with the exception of three years during which he attended the University of Michigan. He is the designer of the Union Pacific's two latest streamliners, the "City of Denver," and is also one of the designers of the new trucks and a number of other mechanical innovations adopted on all Union Pacific streamliners.

**THOMAS J. McDERMOTT**, chief draftsman of the motive power department of the Delaware, Lackawanna & Western, has been appointed mechanical engineer, with headquarters at Scranton, Pa., to succeed



T. J. McDermott

the late Samuel S. Riegel. Mr. McDermott entered the service of the Lackawanna in 1903 as a machinist apprentice in the Scranton locomotive shops. He completed his apprenticeship in the drawing room in 1907, and in 1908 became assistant chief draftsman on locomotive work, power plant and shop layout. In

1910 he was appointed leading draftsman for shop and power plant work and in 1916 became leading draftsman with supervision over the drawing room under instruction from mechanical engineer. He was assigned to special work in 1919 and was in charge of mechanical branch inventory and for I.C.C. Order No. 8 covering equipment, machinery and power plant, reporting to the valuation engineer. Mr. McDermott has been chief draftsman of the motive power department since 1920.

**J. M. KERWIN**, master mechanic of the Illinois division of the Chicago, Rock Island & Pacific, with headquarters at Silvis, Ill., has been appointed district superintendent of motive power of the Chicago, Rock Island & Pacific, with jurisdiction in mechanical matters and with headquarters at Silvis, Ill. Mr. Kerwin was born on January 5, 1884, at Chicago, Ill., and was educated at Armour Institute of that city. He entered railway service on October 27, 1899, as a machinist apprentice on the Chicago, Rock Island &

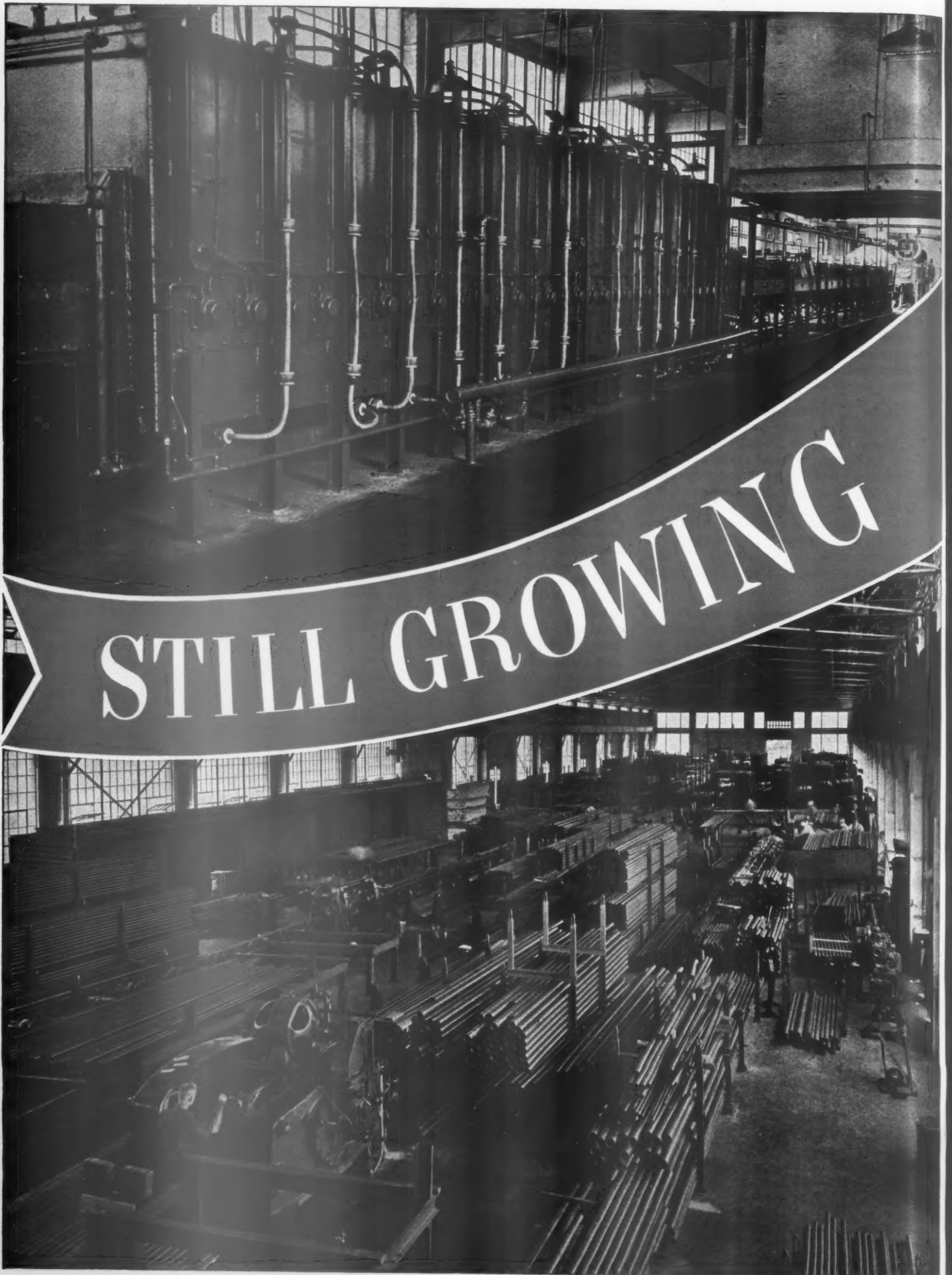


J. M. Kerwin

Pacific, and after serving as a machinist from October 28, 1903, to January 16, 1908, became assistant enginehouse foreman at Chicago. On May 1, 1911, he was promoted to enginehouse foreman at Silvis, Ill., which position he held until April 1, 1915, when he was appointed general foreman at Cedar Rapids, Iowa. Since April 10, 1916, he has been a master mechanic, being located at Estherville, Iowa, until January 31, 1918; at Silvis, Ill., from that date to April 15, 1919; at Goodland, Kan., from the latter date to May 16, 1923; at Trenton, Mo., from the latter date to October 15, 1926, and at Silvis, Ill., from the latter date to July 1, 1936, when he became superintendent of motive power of the First district.

**D. S. ELLIS**, mechanical assistant to the vice-president of the Chesapeake & Ohio, the New York, Chicago & St. Louis and the Pere Marquette, has been appointed chief mechanical officer of these roads and will report to the vice-presidents in charge of operation of the respective roads. In his new position Mr. Ellis takes over a portion of the duties of the late W. G.

(Continued on second left-hand page)



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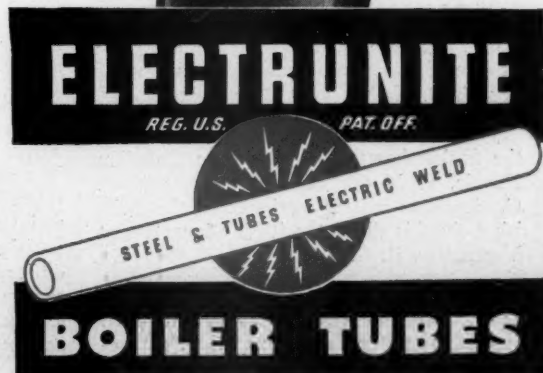
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Black, vice-president in charge of purchasing, stores and mechanical matters. He will have his headquarters as before at Cleveland, Ohio. Mr. Ellis was born at Warwick, N. Y., on January 25, 1897, and attended the Warwick high school. In 1916 he became a clerk in the auditor's office of the Lehigh & Hudson River, and



D. S. Ellis

in the following year he was appointed a clerk in the office of the auditor of freight accounts of the New York Central. Later he served as a machinist and as acting enginehouse foreman. In 1918 Mr. Ellis became a draftsman, serving in this position and as a setter, calculator, designer and traveling engineer until 1924. In that year he was appointed assistant engineer and in 1925 became assistant engineer of motive power. On May 1, 1929, Mr. Ellis was appointed eastern district manager, and subsequently manager, of the railroad division of the Worthington Pump & Machinery Corporation. On October 1, 1932, he resigned from the latter position to become engineer of motive power on the advisory mechanical committee of the Chesapeake & Ohio, the Erie, the New York, Chicago & St. Louis, and the Pere Marquette, with headquarters at Cleveland. Early this year he was appointed mechanical assistant to the vice-president of the C. & O., the Nickel Plate and the Pere Marquette.

#### Master Mechanics and Road Foremen

W. H. LONGWELL, general foreman of the Baltimore & Ohio at Fairmont, W. Va., has been appointed acting master mechanic, with headquarters at Benwood, W. Va.

G. H. NOWELL, division master mechanic of the Canadian Pacific at Moose Jaw, Sask., has been appointed master mechanic of the Saskatchewan district, succeeding Joseph P. Kelly.

JOSEPH P. KELLY, master mechanic of the Saskatchewan district of the Canadian Pacific, at Moose Jaw, Sas., succeeds E. G. Bowie as master mechanic of the British Columbia district, with headquarters at Vancouver, B. C.

A. MAYS, general foreman of the Canadian National at Edmonton, Alta., has been appointed master mechanic of the Portage-

Brandon Division, with headquarters at Winnipeg, Man., succeeding D. W. Campbell, retired.

F. D. BALDINGER, master mechanic of the Baltimore & Ohio at Benwood, W. Va., has been appointed acting district master mechanic of the Maryland and West Virginia districts, succeeding A. E. McMillan, who has been granted a leave of absence because of illness.

#### Car Department

A. L. LOONEY, superintendent car department of the Union Pacific at Omaha, Neb., has been appointed general car inspector, with headquarters at Omaha.

#### Shop and Enginehouse

J. THOMSON, assistant locomotive foreman of the Canadian National at Coalspur, Alta., has been transferred to Edson, Alta.

A. CLIFTON, locomotive foreman of the Canadian National at Drumheller, Alta., has been transferred to the position of locomotive foreman at Calgary, Alta.

M. A. CARDELL, locomotive foreman of the Canadian National at Calgary, Alta., has been appointed general foreman, with headquarters at Edmonton, Alta.

C. F. MCKINNEY, office engineer of the Erie, with headquarters at Cleveland, Ohio, has been promoted to supervisor of tools and machinery, with the same headquarters, to succeed N. B. Emley, deceased.

W. S. SPENCER, a machinist of the Canadian National at Edson, Alta., has been promoted to the position of assistant locomotive foreman, with headquarters at Coalspur, Alta.

E. G. BOWIE, master mechanic of the British Columbia district of the Canadian Pacific, with headquarters at Vancouver, B. C., has been appointed works manager of the Ogden shops.

A. D. MACMILLAN, assistant locomotive foreman of the Canadian National at Edson, Alta., has been appointed locomotive foreman, with headquarters at Rocky Mountain House, Alta.

H. BAYLIS, locomotive foreman of the Canadian National at Rocky Mountain House, Alta., has been transferred to the position of locomotive foreman at Drumheller, Alta.

#### Purchasing and Stores

C. E. SWANSON, storekeeper on the Chicago, Burlington & Quincy at Galesburg, Ill., has been appointed traveling storekeeper, with headquarters at Chicago, to succeed Hal D. Foster.

G. O. BEALE, assistant to the vice-president of the Chesapeake & Ohio, the New York, Chicago & St. Louis and the Pere Marquette, with headquarters at Cleveland, Ohio, has been appointed chief purchasing and stores officer of these roads, in which position he succeeds to a portion of the duties of W. G. Black, vice-president in charge of purchasing, stores and mechanical matters of these three lines, who died on June 20.

#### Obituary

JOHN O. LOONEY, general air-brake inspector of the Norfolk & Western at Roanoke, Va., died on June 25. Mr. Looney had been in the service of the N. & W. for 37 years.

EDWARD J. THILL, engineering assistant to the assistant to the president of the New York Central, died on July 11 at his home in New York at the age of 54 years. Mr. Thill had been in the service of the New York Central for 37 years and at the time of his death was connected with the rolling stock division.

#### Trade Publications

*Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.*

LANDIS THREAD CUTTING EQUIPMENT.—Data concerning actual results obtained with Landis threading machines, die heads and collapsible taps are contained in the performance bulletin issued by the Landis Machine Company, Waynesboro, Pa.

TOOL AND ALLOY STEELS.—The shop data on tool and alloy steels presented by Joseph T. Ryerson & Son, Inc., Chicago, in its general data booklet of 192 pages, are non-technical and have been prepared to assist in securing and properly handling special steels.

FABRICATION OF 18-8 CHROMIUM STEELS.—An eight-page illustrated booklet issued by the Linde Air Products Company, 30 East Forty-second street, New York, discusses improvements in the technique of fabricating 18-8 chromium steels and the actual welding procedure.

STEAM DROP HAMMERS.—The operation of the balanced slide valve on Chambersburg steam drop hammers is uniquely illustrated by moving a slide up and down on the colored diagram presented in the four-page folder issued by the Chambersburg Engineering Co., Chambersburg, Pa.

DIESEL-ELECTRIC LOCOMOTIVES.—An illustrated record of the 113 Ingersoll-Rand Diesel-electric locomotives now in operation has been issued by the Ingersoll-Rand Company, 11 Broadway, New York. Under each illustration is a brief record of the number, horsepower and tonnage rating of each locomotive, also the date placed in operation and the months of service to January, 1936.

CONSOLIDATED CATALOG.—The American Brake Shoe & Foundry Company, New York, has issued Bulletin 36, of 32 pages, illustrating the products of its 13 subsidiary companies. Among products applicable to the railways are brake shoes, armored curbing, manhole covers, gratings, grate bars, gears and other machinery parts, babbit metal, journal bearings, trackwork and manganese steel castings, car wheels, welding rods and crossing signals.